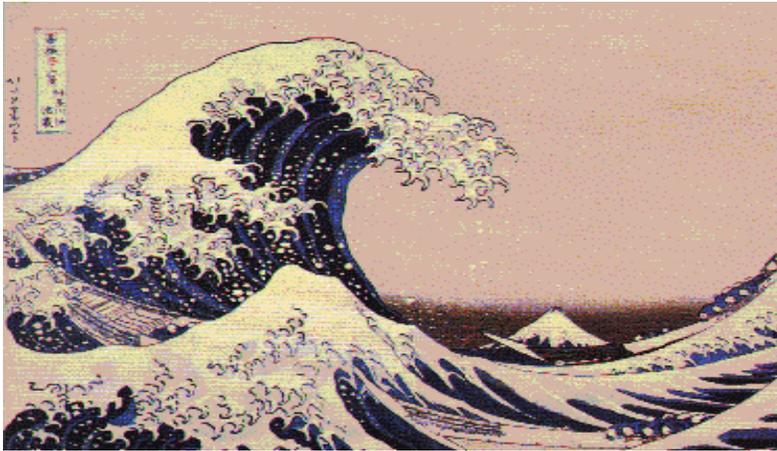


# TSUNAMI

## CHAOS *and* global HEART

*global heart* of support after the *tsunami*  
as the self-organization of complexity



**CHAOS** as *order* and *disorder* intertwined  
*Complexity* **H**idden **A**midst **O**bserved **S**implicity  
*and the reverse*  
*Simplicity* **O**bserved **A**midst **H**idden **C**omplexity

*find the hidden chaos in this book – nonlinear, with some order  
in its apparent randomness*

what **Bruce W Powe**, Professor of English  
at York University  
and author of  
**Towards a Canada of Light**,  
says of this book

*“This is a work of visionary intensity,  
of visionary range.*

*New, alive,  
inspiring,  
and in itself a model of the  
dynamism of which it speaks.  
He brings back the magic of reading too  
by changing your perspectives,  
enlarging them,  
while you engage his words.*

*Grow the soul,  
**grow the heart.**  
This is our imperative now.”*

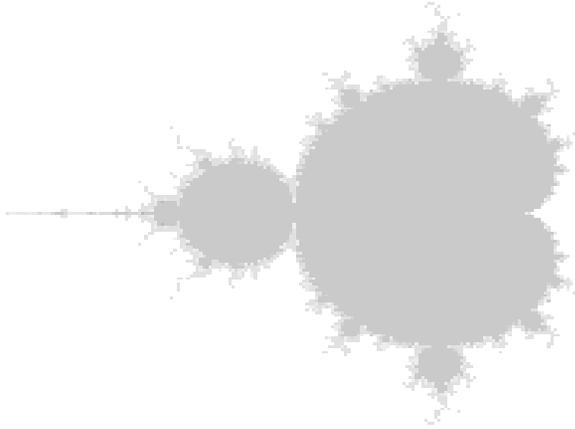
**TSUNAMI**  
**CHAOS and global HEART**  
*using complexity science to rethink  
and make a better world*

*with reflections on chaos, complexity, fractals, heart health,  
South Asian Heart, tsunami...and just plain **heart***

**Vivian S Rambihar**  
*with Sherryn Rambihar and Vanessa Rambihar*

Vashna  
contact: [vrambihar@rogers.com](mailto:vrambihar@rogers.com) Toronto 2005

Let's start with *heart*...



...*global heart*

*a fragile fractal global heart emerging after the tsunami.*

*This is a Mandelbrot or Julia set **fractal**, one of the most beautiful images in mathematics. It is computer generated from the simple equation  $z = z^2 + c$  of feedback and change as occurs in nature, society and human affairs. It shows **the patterns of chaos - order and disorder intertwined**, with similar but not identical patterns at different scales. It reveals a new way to see the world, with a new thinking on how and why things happen, which can become a **lever or tool for change** in the complexities of our interconnected and interdependent world. (Please see web for more images).*

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### Reading Choices

1)

*To iterate or frame this book in the perspective of new ideas during 2005, as in the equation*

$$z = z^2 + c$$

**Read on** for 2 page summary, or

2)

*For full discussion please go to p 303.*

3)

*To read as originally written please go to page 12*

4)

*To learn some more about chaos and complexity now – please go to p 8, p 65 and 323 (pictures)*

5)

*To learn how to recognize chaos and complexity in nature, society and in organization, please go to p 8 and 65*

Be the change you want to see in the world.

Mahatma Gandhi

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**after 307 Update 2006, 2007 and More on Fractals**

*notes from 2006 Review one year later on p307*

*It has been a bad year, starting with the Tsunami.*

*But it has been a good year for support and change.*

*Chaos became a new mathematics of complexities in 1975*

*Complexity from the 1990's uses ideas and metaphors from the math of chaos to apply them to the world. It is a new and useful perspective and tool for change.*

*Complexity ideas are already at work in the world in the distributed collaboration mentioned by Friedman in The World is Flat, the many local initiatives worldwide and in the new thinking on improving conditions to allow a better world to emerge.*

*This book seeks to **globalize heart**, by using the inspiration of the global support after the tsunami to invite us to remain involved.*

***“In 2005 the world's poor needed no more condolences; they needed people to get interested, get mad and then get to work.”** Nancy Gibbs concluding her December 26, 2005 Time Magazine article, naming Bono and Bill and Melinda Gates as Persons of the Year, “The Good Samaritans,” exactly one year after the Tsunami.*

*Josh Tyrangiel writes in the Time Magazine, 26 Dec 2005, exactly one year after the Tsunami, that **one of the ways to spark a movement is to create a defining moment.***

*On the 26<sup>th</sup> of December 2004, a defining moment was created for us, the chaos of the tsunami. A complexity type global heart movement was sparked; people got interested, got mad and then got to work.*

*It has been a good year for such support and what it has achieved. This needs to be sustained and improved, with new ideas added, to achieve previous goals, and to set and achieve new ones.*

*This book on Tsunami, Chaos and Global Heart pays tribute to everyone involved or interested, and **begins and ends by inviting you to remain mad, and to sustain the global heart of support sparked by the defining moment of the chaos of the Tsunami.***

***Your involvement now is as important as ever.***

*Sharmila Pathmanathan's lingering words in the Globe and Mail newspaper exactly one year after the tsunami, captures our sentiments best, bringing together the mind and the heart, inspiring us to make a better world.*

***“The memory of the tsunami stays in my heart.”***

In his book “**Blink: The Power of Thinking Without Thinking**” Malcolm Gladwell asks us to hold the analysis and to take our instincts seriously in making decisions in complex situations. He feels that many such small choices to influence the way we do things will add up and make a different and better world. He says that there can be as much value in the blink of an eye as in months of rational analysis.

Michael LeGault responds with his book “**Think: Why Crucial Decisions Can’t be Made in the Blink of an Eye,**” arguing for factual knowledge and critical thinking in decision making. He is concerned about the Age of Emotion replacing the Age of Reason, with adverse consequences for society and the world. LeGault says that its time to wake up and think.

This book says it is time for both emotion and reason, which are contained fractally in each other, **to rethink and make a better world**. Our emotional response to the tsunami led to unprecedented global support, while critical analysis leads to new ways for aid delivery, reconstruction and sustained development. An emotional response to the crying needs there and everywhere else combines with a rational and critical analysis to fashion a future for the world.

Complexity science allows us to **rethink** the world, bringing together the mind and the heart, reason and emotion, so we can **blink, think and rethink**. As Blaise Pascal said “**The heart has its reasons, which reason does not understand.**”

## Observe and rethink the world

### **CHAOS THEORY**

**Quantitative** study of nonlinear dynamic systems, order and disorder intertwined, includes the irregular and unexpected.

### **COMPLEXITY**

**Qualitative** (ecosystem type) study of web-like interactions that feedback and change. Uses metaphors of chaos theory.

**CHAOS: C**omplexity **H**idden **A**midst **O**bserved **S**implicity  
and the reverse (mine, not an official definition)

### **SEARCH FOR CHAOS**

Outcome determined by past. Neither random nor regular patterns  
Tiny input feedback/spirals to cause major change (**sensitive dependence**). Some uncertainty (**strange predictability**)  
Self similar but different patterns (**fractals**). Constant change and interconnectedness. Patterns or “basins” of attraction (**strange attractors**). Sudden bifurcations (**criticality**). Emergence and collapse

### SEARCH FOR COMPLEXITY (*features of chaos*)

Systems that keep changing, with web-like network of non-linear interactions. Prediction and control limited. Patterns and behavior. Interconnectedness, feedback, self organizing, emergence of new patterns - fractal and non-fractal. Process not states, multiple perspectives, diversity, autonomy, distributive, context, real world.

**Examine the things you deal with:** *If you call them complex or you find they have elements of complexity, then think of them in complexity terms and use complexity to achieve change.*

## How to use complexity for change

Use chaos~complexity ideas to maintain a dynamic balance of usual and newer ideas, moving between complexity and ordered, central and distributed, self-organizing and facilitated or directed, adjusting according to need, context and circumstance.

### LEAD AND TRANSFORM WITH COMPLEXITY

Accept uncertainty and constant change, focus on values and purpose as a guide towards desired outcomes. Encourage both expert opinions and self organizing emergence of ideas. Remain in touch with the periphery, which is also central. Function as a learning network with interaction, feedback and adaptation. Use the fractal patterns. Facilitate emergent change from within.

### MANAGING COMPLEX ADAPTIVE SYSTEMS

from Brenda Zimmerman (Edgware see web)

Good enough vision, not plan every little detail  
Tune system to edge of chaos with right degree of information flow, diversity/difference, connections inside and outside, etc  
Uncover and work with paradox  
Listen to shadow system – informal etc

### NEW RULES OF THUMB (FEW RULES) from D Kernick:

Complexity in Healthcare Organization. Radcliffe Press 2004

Innovate

Take risks and foster innovation

Develop new ways of working

Learn from failure

Change needs from top down to bottom-up

Reflect local needs

Motivate and empower NOT detailed commands

***Most writers and thinkers see the world as complex.***

Complexity science allows us this novel perspective on how things happen and provides a new tool for change.

Economics Nobel Laureate, Amartya Sen, describes *poverty* as a ***complex, multifaceted*** word that requires a clear analysis in all its dimensions, with ideas to make a better world reflecting such complex interactions. His forthcoming book *Identity and Violence: The Illusion of Destiny* “challenges the reductionist view that people of the world can be partitioned into little boxes” (from the website). Fractals provide a new model for a dynamic and complex identity, as thinking outside those boxes.

Jeffery Sachs uses the word ***complex*** often, in his book “The End of Poverty” and describes the interconnected challenges of climate, environmental management, conservation, public health, and economic development. He proposes a new clinical economics for development based on complex systems and other ideas from modern medicine, to which complexity should now be added. Barrett and Swallow describe *Fractal Poverty Traps* in *World Development*, January 2006 (search web for full text), with implications for new ways for escape and change.

While describing a global compact for development, Sachs says that, ***“in the end, it comes back to us, as individuals,”*** and that “individuals working in unison, form and shape societies.” Sachs also argues for harnessing global science “as a fulcrum by which reason is translated into technologies of social advance.”

***Complexity is the new global science, complementing science as we know it, and which, together with global heart, can now be harnessed to make a better world.***

Start here

for

The original book

completed

Valentine's Day Feb 2005

*The heart has its reasons, which reason does not understand.* Blaise Pascal.

*Over 250,000 people lost their lives in the South Asian Tsunami of 2004, with millions left homeless.*

There is no way to peace. Peace is the way.  
Mahatma Gandhi

*Eight million people die  
each year  
because they are  
too poor to stay alive*

*In the time it takes you to read  
this box  
seven children will die  
as a result of extreme poverty  
[www.makepovertyhistory.ca](http://www.makepovertyhistory.ca)*

There is no way to heart. Heart is the way.

The global heart emerging after the tsunami  
is complexity science at work...

In every disaster, we learn something new.  
Jennifer Leaning  
Harvard School of Public Health

Let us learn from the tsunami and make a  
better world.

*Stephen Hawking says "I think the next century  
[21<sup>st</sup>] will be the century of complexity"*

Let us use complexity science  
to make a better world...

Just by reading this,  
you have already started to change the world

to sustain change  
think more, read more, make your own  
action plan or join others already involved.

...and sustain the global heart emerging  
after the tsunami.

Global Heart invites you  
to **rethink**  
and **change** your world

***Ways to change***

See the world differently through complexity

Think interrelatedness and interdependence

Make complexity the way to change

Support Tsunami reconstruction

Support the other “tsunamis” elsewhere

Support existing organizations

Create your own way

Think **heart** and **global heart**

I've always believed that when there is one part of the human community under siege, it is necessary for us in the privileged part of the human community to respond, with decency, with justice, with urgency, and with compassion.

Stephen Lewis

Harvard School of Public Health Address 2005

# TSUNAMI CHAOS and global HEART

*using complexity science to rethink and make a better world*

*Copyright 2005, VS Rambihar  
with Sherryn Rambihar and Vanessa Rambihar*

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using complexity science to rethink and make a better world*

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***Dedication***

to all involved with the tsunami in any way  
 everyone striving to make a better world  
 and the vulnerable everywhere

***Acknowledgements***

Nadira Rambihar,  
 Vanessa Rambihar  
 for manuscript preparation and review

***Notes***

This book can be read in a nonlinear fashion,  
 selecting pages of interest in any order  
 making it somewhat repetitive,

***nice numbers - Marking 2005***

this book celebrates in 2005  
 30 years from my graduation in medicine 1975  
 30 years of modern chaos, named by Li and Yorke 1975  
 25 years of my cardiology practice in Toronto, from 1980  
 15 years of my using chaos and complexity in ...everything 1990  
 10 years from the writing of CHAOS: from Cos to Cosmos 1995  
 5 years from the writing of A New Chaos Based Medicine - 2000

***Warning – Disclaimer***

the purpose of this book is to educate and to encourage debate. The  
 author and publisher shall have neither liability nor responsibility  
 to any person or entity with respect to any loss or damage caused  
 or perceived, directly or indirectly by this book

*also by VS Rambihar*

***CHAOS 2000: From Cos to Cosmos:***  
Making a New Medicine for a New Millennium

***A New Chaos Based Medicine Beyond 2000:***  
the response to evidence

***South Asian Heart:***  
Preventing Heart Disease: from the heart to the edge of the  
diaspora: from the heart to the edge of chaos

another theme of this book is

***connections***

- people, word, or any other kind.

*Can you think of any connections between*

***tsunami***

***chaos                      and                      heart***

.....  
.....  
.....

*or between yourself and the tsunami, chaos or heart.*

***Keep thinking about connections as you read this book.***

*“The most incomprehensible thing about the universe is that it is comprehensible.”*  
Albert Einstein

*Tsunamis are not entirely unpredictable; there is some order to the chaos. Chaos imposes a subtle order to the chaos of things.*  
VS Rambihar

The **tsunami** awakens us to the power of **chaos**  
and the ensuing global **heart** awakens us to  
the power of chaos and complexity as a tool for change.

*this is a word and idea **connection**  
can you think of others?*

*“Deep down we know that the world is not really chaotic and capricious...We are intimately connected to the cosmos...We are part of a self-similar pattern reflected throughout the universe...We share a thrilling pulse with a huge part of the world, the solar system and the universe at large.”*

Mark Ward in *Beyond Chaos:*  
*the underlying theory behind life, the universe, and everything.*

*For the imagination age, we should replace swords and ploughshares with fractals, chaos and complexity.*

We can now go beyond chaos and complexity, as understanding the world, to use it as a tool for change. Global health should become global health and humanity, or **global heart**.

They shall beat their swords into ploughshares, and their spears into pruning-hooks; nation shall not lift up sword against nation, neither shall they learn war any more.

The Bible, Old Testament, Isaiah ii

*"I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century."*

Heinz Pagels, physicist, 1988.  
Former President NY Academy of Sciences

*“Scientists tell us a butterfly flapping its wings in the Amazon rainforest can generate a violent storm on the other side of the earth.”*  
Kofi Annan

Nobel Peace Prize Acceptance Speech 2001,  
on the Butterfly Effect of chaos theory.

It is said that everyone on Earth is separated from anyone else by no more than *six degrees of separation*, or six friends of friends of friends.

This started in 1967 when sociologist Stanley Milgram created what is known as the "***small world phenomenon***." You can look this up on the internet or type in any of the key words above in Google.

There is a mathematics of networks, which is chaos and complexity, that describe such connections. See more on internet or books by D Watts, Albert Lazlo Barabasi and Mark Buchanan. (The internet itself is the best example of such chaos and network connections).

The Butterfly Effect mentioned above shows another kind of connection, of weather and ecosystems. The human spirit mentioned below shows the human connection. You will find that there are many more connections than you think.

*“The tsunami may illustrate the fragility of human life, but the response to it represents the strength of the human spirit.”*  
Bill Clinton.  
Former US President  
appointed by Kofi Annan as  
UN Special Envoy to sustain world interest post tsunami.

*Mathematics, fractals, and chaos and complexity network connections show us a more global and even cosmic inter-relatedness than we think.*

*“We are travelers on a cosmic journey – stardust swirling and dancing in the whirlpools of infinity.”  
Deepak Chopra*

## Preface

Over 250,000 people lost their lives in the *chaos of the Indian Ocean Tsunami* of December 26th, 2004, with tremendous and unimaginable personal, social and economic loss and millions left homeless. Infrastructure has collapsed and social and family structure disrupted. The region remains a disaster area long after the tsunami has gone.

Out of this chaos has come some good. A *global heart of support emerged*, which now needs to be sustained, for the other disasters and needs world-wide. The tsunami thus caused a rethinking of the world and has become a metaphor for disaster and a Tipping Point for change.

*It has been a bad year*, with the “mountain tsunami” South Asian earthquake, hurricane Katrina, floods in Mumbai, landslides in Guatemala, and many other disasters, in addition to the on-going problems all over the world, much of which we hear little about.

But there has *also been a lot of good* in that time, from reaffirming Millennium Development Goals for 2015, to debt reduction and many global initiatives, all leading to an increasing awareness of the need to work together to make a better world. The issues described are very complex, and require a complexity approach.

The overwhelming support that emerged after the tsunami shows us what can be done together.

We now need to figure out *how to sustain this*.

## *Let's start with the heart*

The Buddhist Heart Mantra.

***Om gate gate paragate parasamgate bodhi svaha.***

*“Gone, gone, gone all the way over, everyone gone to the other shore, enlightenment, Welcome”*

*(this is a fractal)*

***and contemplate Buddha's words***

*“This existence of ours is as transient as autumn clouds,*

*To watch the birth and death of beings is like*

*Looking at the movements of a dance.*

*A lifetime is like a flash of lightening in the sky,*

*Rushing by like a torrent down a steep mountain.”*

Gautama Buddha

*(there's chaos and fractals here too)*

*The deepest secret of the universe is that we may never know how and why it works.*

*The closest we have come so far may be the new science of chaos and complexity, which provides new meanings, models and metaphors for life, the universe and everything else. Included in this everything else are novel concepts, which have spontaneously emerged across diverse disciplines as better explanations and better methods to achieve change in the complex web of interconnections and interactions we share.*

*And in this sharing, we search deeply into and beyond religion, spirituality and philosophy for something more than explanations, for meaning and purpose.*

*The tsunami in all its chaos and fury, revealed for many of us new meaning and purpose, eliciting an equivalent tsunami-like global response of heart - tsunami heart and global heart.*

*Our search for meaning and purpose continues. But our heart beats stronger now, for we are awakened by the tsunami to rethink our world and make lasting change.*

*A Butterfly flapping its wings near Sumatra causes a tsunami of response globally – the tsunami effect of chaos theory.*

*This book discusses all of this and more,  
with **chaos and complexity**,  
the new art, **heart** and science of humanity.*

***“If at first the idea is not absurd, then there is no use for it.”***

***Albert Einstein.***

Applying **chaos and complexity science to heart and humanity**, is my absurd idea. I sense that this is applicable widely across the universe.

Seems I am in good company. Stephen Hawking, the eminent Lucasian Professor of Physics at Cambridge University said,

*“I think the next century [21<sup>st</sup>] will be the century of complexity.”*

*Chaos is a term used by some writers to denote order and disorder intertwined, and thus includes complexity. Others use chaos as the mirror image of complexity. The terms are used interchangeably here, consistent with the former usage.*

*The prestigious Japan Prize for Science and Technology for 2003 was won by Mandelbrot and Yorke for establishing chaos and complexity as fundamental structures of nature, and thus as a serious science.*

Our experience introducing these ideas to health, medicine and humanity over the past 15 years, using chaos and complexity also as a tool for change, has been previously presented and published.

This book seeks to extend these ideas further.

Chaos and complexity makes us rethink the world. This should include humanity and heart. The ideas expressed here wander widely as ***an exploration or journey into the unknown***, which you are invited to join.

## Chaos, a tool for change - beyond disorder and confusion.

When I sent a book on chaos and heart disease to Dr Rienzi (not his real name), who had unexpected heart disease and required an urgent bypass operation, his friend Rocky (his real name), quickly penned these lines to neutralize my apparent catastrophe thinking, following it with *not*, to change it to optimism instead:

“Chaos ...Sky is falling...All is not well...What will happen?  
...Whatever will I do?”..... **“NOT!”**

This captures what chaos means to most people. Order and control giving way to disorder and uncertainty. Rocky’s *not* is the mirror image - all will be well, think positive and book tee times for golf.

*Chaos is not* just order decaying to disorder. Since 1975, *chaos* has acquired a new, technical and scientific meaning, based on the title of a mathematical paper by Li and Yorke “Period three implies chaos” and is used to mean the intertwining of order and disorder (or chaos) in the universe at all scales or levels.

The mirror image of Rocky’s *chaos*, disorder erupting into order or the *not* he ends with, is part of this new definition of *chaos*. The new *chaos* then is as much the optimistic and organizing principles of health as it is with the sky falling and all not being well.

Chaos lifts the sky, and can become a tool for change and a better life. It imposes a subtle order in the chaos of things, with new rules we need to learn to help us understand how it works and how to use it for our benefit.

## Ideas from chaos and complexity science can transform our thinking and make a better world.

There are various ways to change the world. The traditional top down approach of policy directives handed down through various managerial levels now gives way to novel, creative and imaginative ways for change in complex adaptive systems, which are systems with feedback and change.

Ideas similar to those of chaos and complexity now spontaneously emerge everywhere, through trial and error, as something that works. As a transdisciplinary, organizing, management and leadership science, chaos and complexity can be a model for effective change. It emphasizes dissipative structure with multilevel feedback and adaptation. Uncertainty, unpredictability and nonlinear change are expected and anticipated in such systems.

Such tools for change transform our thinking and are increasingly being used or discussed: our community health project from 1990, Thomas Homer-Dixon's ideas in his book, *The Ingenuity Gap: how can we solve the problems of the future*, Deepak Chopra's writing, as in his 2005 book *Peace*, though not specifically mentioning chaos and complexity and Glenn Albrecht and others in a coronary heart disease in Australian Coalfields project (Complexity and Human Health – search web).

A dynamic balance, matching tools and styles with needs and context is required, as during the SARS outbreak in Toronto in 2002, when a centralized team replaced distributed decision making, to respond quickly and effectively with the impending crisis. The challenge is to achieve the dynamic balance necessary.

***Epilogue:*** before you start reading this book.  
(real nonlinear writing)

I have always been curious about how and why things happen. By why, I mean mostly the mechanism, or the way in which things happen, the “governing dynamics.” From an early age I had a sense for chaos and fractals, seeing interrelated things within things influencing each other, and wondered about the “cause” for sudden bifurcations in people’s lives and in societies.

I did not have a vocabulary to express these ideas or ask these questions until I stumbled upon three books and two journal articles - James Gleick’s *Chaos: Making a New Science* in 1987, followed closely by Briggs and Peat’s *Turbulent Mirror* and later Briggs’ *Fractals: The Patterns of Chaos*, and journal publications *Future Imperfect: The limitations of clinical prediction models and the limits of clinical prediction*, JACC 1989 by Diamond et al., and *Fascinating Rhythm: a primer of chaos theory, and its application to cardiology*, Am Heart J 1990 by Denton et al..

After this introduction, I sensed chaos, complexity and fractals in everything, and as good explanations of the irregular and unexpected observed in my practice and in life. With no literature on this available, I began writing to share and explore these ideas.

A team of colleagues at The Scarborough Hospital in Toronto explored this further with me, using chaos not only as an explanation, but designing chaos into health projects as a tool for change. All along I felt that chaos, and later complexity, were central to everything and proceeded to write about this. More convinced now than ever, I sense a chaos permeating everything, from the ordinary to the extraordinary, from quarks to quasars, from the deep recesses of the cells to social dynamics and peace, and even from thoughts and actions to changing thinking.

Hence this book, bringing together my experiences and thoughts on chaos and heart. It proposes a new thinking for heart, heart health and health promotion, and everything else, from preventing the obesity epidemic to peace, poverty reduction and development. These ideas now receive increasing support. Independently, all over the world, a similar thinking is emerging, from all directions and in and across various disciplines.

The tsunami and the subsequent global heart emerging give me an opportunity to explore and share these ideas even more.

The ideas and insights from fractals, chaos and complexity ***provide new perspectives on life, the universe and everything else***, including much of the ills of the world, and can be used to create *transformation and change*. Deepak Chopra invites a new thinking for peace, quoting Mahatma Gandhi “There is no way to peace. Peace is the way.” This is essentially a chaos type thinking without using the words, showing that these ideas are not new, only newly resurfacing. (They actually existed in the art, writings and practice of ancient civilizations, religions and current Eastern philosophy).

I feel the same about heart, from tsunami heart to the emerging global heart; that there is no way to heart - heart is the way. And the best way for heart to change the world, may be by using chaos and complexity as a tool for transformation and change. Our 1994 Diversity and Health project showed us that it can work.

***It's all about heart.*** Let's make heart the way to make a better world. Use your imagination, creativity and heart to do this in whatever way you think possible. Either design a project or just start, making it up as you go along. Our Tsunami Valentine's Day Event at The Scarborough Hospital started without much planning,

and will evolve to become Valentine's Day for Global Heart. We hope to refocus the world to think Global Heart on Valentine's Day. We focus too much on buying things we don't need at that time. We hope to channel some of that energy and money to where it makes a bigger difference, while also improving heart health.

A **2 minute heart** was started, to use social and other functions to add a 2 minute warning for heart health. The people we need to reach do not attend heart health discussions or seminars. Mentioning heart for just 2 minutes at places where people are already gathered for other reasons, will reach many more people, stimulating them to seek more information or access resources. We will now **add global heart** to this so people gathered for other occasions will become exposed to a new global heart message. We invite you join us in this exciting new way to make a difference, which, with your involvement, may well transform the world.

All my life I have been trying to figure out how to encourage more heart for the world. I was searching for a way to heart. Since 1980 when I started cardiology practice I looked for ways to do something for heart and cardiology for the developing world. But all I could find relevant then was research and writing on tropical diseases of the heart, which wouldn't do it. I read about development ideas and how to become involved, but it seemed a field unto itself. So I became involved with the various local and global things mentioned earlier. ***Then came the tsunami.***

After the tsunami, and after seeing the outpouring of heart, with a global heart emerging, I realized that the answer was there all along. As a cardiologist I should have known.

*There is no way to heart. Heart is the way.*

*Think heart*

*global heart*

## Introduction Why this book?

This book invites us to *rethink the world* and *create change*, now that the *tsunami* is *gone*. The images linger. We all want to be involved. Those images can help us rethink the world, going beyond imagination to use chaos and other ideas expressed here to *change the world*. It doesn't require much.

This is a somewhat random, somewhat ordered collection of *reflections* to hold as a memento of our shared experience surrounding this unprecedented disaster. It makes interesting *connections*, bringing together ideas from many directions in a trans-disciplinary fashion, the kind of *novel thinking* that may be what's required to *make a better world*. It reflects on a *global heart* emerging, which involves us all.

I have written books on chaos and complexity science, using it to understand the irregular and the unpredictable, (as well as the usual and regular), and *how and why things happen*, and another book on *South Asian Heart*, referring both to heart disease and *heart*, the more emotional and abstract concept of heart as feeling for *humanity*.

As a physician and cardiologist exploring new vistas, I have described medicine as the art and science of caring for humanity and written a 2000 word Millennium essay on *heart* (*reprinted in this book*), from this perspective, wandering into *chaos and complexity science*, and even wrote a

bit about *tsunami like waves in the brain* as a *quantum chaos theory of brain function* in a book on chaos in medicine. These waves are what make us think, feel, reflect and then act. From the Einstein Theory of Absurdity, *if at first the idea is not absurd, then there is no use for it*, this one should have lots of use.

The cataclysmic events in December 2004, where the earth shook and chaos reigned in South and South East Asia, bring together all of these ideas in a chaotic jumble of somewhat ordered interconnections.

Nothing will bring back the lives lost or lessen the suffering, but discussing these things may offer some solace for us, grasping for understanding, knowing full well that there are likely no clear answers.

I write this also to share in the communal grief, hoping that these words can heal a bit of the sorrow we all feel and in some way lead to learning, and somehow, to a better world.

We all yearn to do something. Writing is what I do, mostly about things that bother me. I write for myself, and for readers for whom these words have meaning, and for all those who have been touched in any way by the tsunami.

This is also a bit of an intellectual journey, into untrodden territory and uncharted seas, which may as easily enlighten as confuse. It is written for the general reader and clearly too simple for some and too complex for others. The sources are secondary, mostly newspapers, magazines and the internet, rather than journals and technical papers. Google, that chaotic fractal web of instant global

connections, and the best example of chaos, provided invaluable research for this book as it did for Deepak Chopra's 2005 book *Peace*. The web is also increasingly used as a tool for global change, a novel practical application of chaos and complexity.

This book is meant as a memento, something tangible to hold and feel, to remind us of that day in 2004 when the earth shook, unleashing one of the biggest natural disasters in recent history, with the largest humanitarian aid effort ever.

It attempts to discuss how and why.

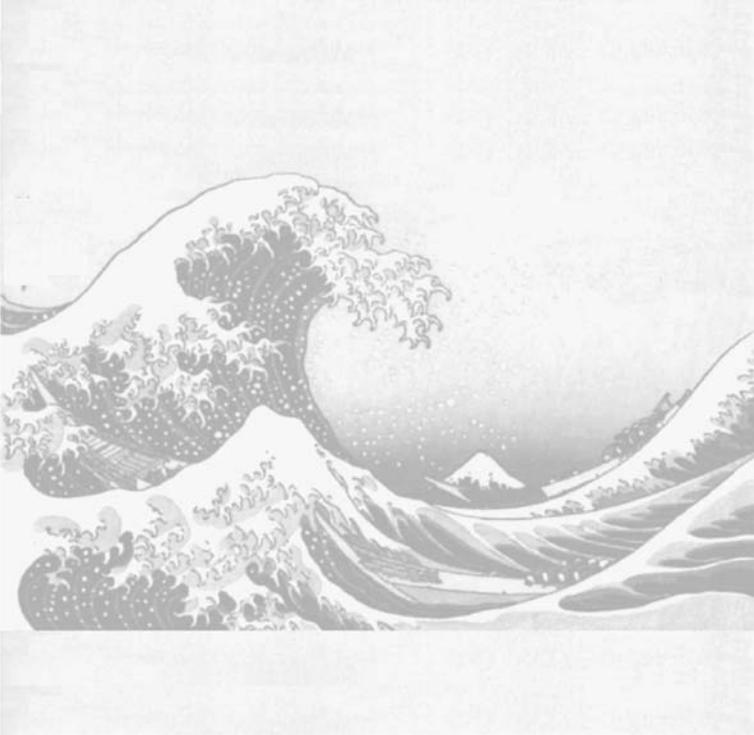
Disaster experts who have seen everything say that this one is the worst, with the sudden unexpected widespread devastation that looks like what they would imagine from a nuclear blast.

It makes you think, and it made me write.

I hope it makes us all ***rethink and change the world***.

*You, the reader, will write your own unique book in your mind on reading this one, weaving, in a complex dynamic (chaotic) fashion your own experiences, thoughts and perspectives into the ideas expressed, taking from this interaction what you wish.*

*The words and phrases in bold are either random or recurrent themes you may wish to find and explore further, contemplating the validity or otherwise of their **meanings and connections** many of the connections here are obvious and make sense. Some seem to hang by a slender thread in a chaotic though not random fashion, but may well be considered by others as strong and robust. It is exciting to make these connections, an adventure, much like going to a party and meeting new people, hearing new things, and seeing them in a new light.*



What do you think of when you see this image?

There are wavelets within waves within waves, all different but still a bit similar. They dwarf a mountain in the background, which happens to be Mt Fuji in Japan. One of the waves has the same appearance as Mt Fuji. It is all very dynamic, with patterns of stability mixed with turbulence, and with a monster wave breaking into white water. There the wavelets seem to morph into something else – seagulls.

We planned a small *tsunami heart global heart event in Toronto* at our 22<sup>nd</sup> Annual Valentine's Heart Health Event at The Scarborough Hospital, illustrating unusual connections. I am not sure exactly why we did this. I just know that it had to be done.

It seemed only natural to do so, Toronto having one of the largest Sri Lankan, South Asian and South East Asian communities outside Asia, the communities devastated most by the tsunami. Yet, we were not planning to raise money or ship clothes or medicines. That was already done separately.

Then it struck me, after reading Dr Marla Shapiro's Globe and Mail, Feb 1, 2005 column "Tsunami's horrors stressful here too." It reminded me that we are all affected in some way by the tsunami, and it may have become a defining or pivotal point in our lives. It was stressful and forces us to ask deep questions and to seek understanding of how and why such disasters happen and what could be done to prevent or reduce the effects of others. It brought home to us closely how people a world apart live, and we feel for them and their future.

It reminds us that there is a big world out there beyond our day to day concerns, a world about which we know little and can no longer go on living without caring. Our tsunami event is about sharing and caring, about thinking and rethinking, and doing whatever we can to create change. And we know that in a world of chaos and complexity a little can create a lot of change.

*A seagull flapped its wings in the Indian Ocean that day.*

a *seagull flapping its wings* in Sumatra causes an outpouring of global heart everywhere. This is the new Tsunami Butterfly Effect of chaos theory. The Butterfly Effect quoted by Kofi Annan at his Nobel Prize Acceptance Speech in 2001, mentioned earlier, started life as a seagull effect.

MIT meteorologist Edward Lorenz returning from coffee one day in 1961, found his computer predictions of the weather way off, after he had rounded off the third decimal place. This illustrates sensitive dependence on initial conditions in a nonlinear dynamical system, like complex web-like interactions, where very slight changes spiral through the system leading to a dramatic and unpredictable difference in outcome.

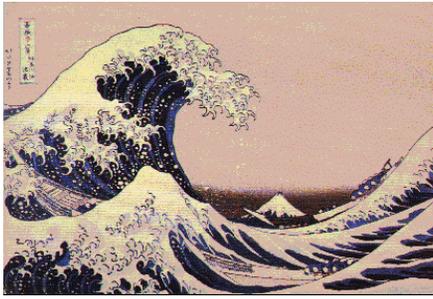
He used the expression “a seagull flapping its wings” to capture the essence of the findings, but the title was changed by the chair of the session at which he presented, to “does the flap of a Butterfly’s wings set off a tornado.” For the benefit of alliteration Lorenz changed it later to “A butterfly flapping its wings in Brazil causes a tornado in Texas.”

At the same time, Yoshisuke Ueda in Japan had observed a similar chaos in the cracked shell appearance of his plots from an electrical engineering experiment, Benoit Mandelbrot had described the self-similar patterns of fractals and Li and Yorke reported their “Period three implies chaos” math paper, giving rise to the name *chaos* for all of these observed phenomena.

This is how the seagull and the butterfly flapping their wings got their name, and fame as metaphors for chaos and reality.

***Great wave fractal:***

The tsunami on the cover of this book shows a wave breaking into smaller and smaller wavelets eventually morphing into seagulls, somewhat Escher like. The



self similarity of the waves at different scales, with some similar features through the different levels illustrate *fractals* - self similar patterns at different scales, a feature of chaos and complexity.

The creator of this wave, Katsushika Hokusai (1760-1849) was a Japanese painter and printmaker from the Edo Period, most famous for his series of prints called "Thirty-Six Views of Mount Fuji."

*The Great Wave* or *In the Hollow of a wave off the coast of Kanagawa*, is the most popular of Hokusai's images depicting the fractal aspects of nature, very much similar to the intricate detail of Julia sets we see on computer images of fractals, and on the cover of this book. Perhaps these mathematical derived fractals appeal to us more since they mimic some of the patterns observed in nature.

If we look closely, we may see such patterns widely across the physical universe, as well as in the social and other patterns that enmesh and connect us. The images of the tsunami and waves breaking into seagulls, or of butterflies, like on the cover of Chopra's *Book of Secrets*, or Mark Ward's *Beyond Chaos*, could take us beyond the graphic images of destruction of this tsunami to ones of creativity, reconstruction and reshaping the world.

***Out of the chaos of the tsunami arises something new, emergent and self-organizing, heart - a new global heart emerging.***

What does tsunami, chaos and heart have to do with each other anyway?

# TSUNAMI CHAOS and HEART

*meanings and definitions*

This book explores the many connections  
between tsunami, chaos and heart.

**Tsunami:**

*A very large ocean wave caused by an underwater earthquake, volcanoes or mudslides into the ocean.*

*Japanese word meaning harbour wave, since Japan has a lot of tsunamis. Previously called tidal wave, but not related to tides in any way.*

**Chaos:**

*Confusion, or disorder, probably first used as such around 300 BC by the stoics.*

*A gap from which everything arose, in Greek, and other mythology.*

*A new science (1975) of complex interactions.*

**Heart:**

***The center of everything.** The fulcrum of the cosmos (from the Upanishads) with cosmos meaning everything. Became the metaphor for love, romance, emotion, feeling, concern, etc. More importantly **heart is caring and sharing.***

**Fractal**

*a term from chaos science: means self-similarity with some difference at different scales; from **fractured**, as broken, and **fragment** meaning part and whole, diverse and entire, heart and edge at the same time. Like wavelets, within waves, within waves.*

The **tsunami** chaos has done much more than  
evoke a global tsunami heart response.

*It has made us rethink our world, after the tsunami.*

*It invites us to learn about chaos and to explore another  
**chaos**, the new science of chaos and complexity and  
how it can be used to make a better world.*

*This new science now gives us new meanings, models  
and metaphors for making a new world.*

*Emerging from the tsunami is heart, a fragile, fractal  
global **heart**, which we need to nourish, to keep  
beating strong, long after the tsunami is gone.*

“Science and Buddhism are very similar, because they  
are exploring the nature of reality, and both have the  
goal to lessen the suffering of mankind.”

*The Dalai Lama at MIT, referring to current science.*

Chaos and complexity science shares even much more  
common ideas with Buddhism.

“Gone, gone, gone all the way over, everyone gone to the  
other shore, enlightenment, Welcome”

from the Buddhist heart mantra.

A physicist, physiologist, physician, philosopher  
(sorry, perhaps stretching it a bit) may notice

***another connection  
between  
tsunami, chaos and heart.***

***Tsunami*** is a peculiar kind of wave called a  
soliton, which behaves in a ***chaos*** science  
nonlinear dynamics fashion.

Some scientists feel that such waves may happen  
everywhere in the body, in the proteins, DNA,  
cells and enzymes, including the ***heart*** and the  
brain. Brain tsunamis may well be responsible for  
thought and caring and thus ***tsunami heart, global  
heart*** and rethinking our world.

*Timothy Ferris wrote a little book The Universe and Eye,  
suggesting that the universe is in the eye of the beholder,  
since the eye is where the images are received.*

*At a deeper level, the universe is in our brain, in the  
tsunamis that cascade around our neurons. Tsunamis  
create the images of our world, create our thoughts and  
emotions and create our responses and actions.*

*Education of the heart*

Daniel Pink mentions this in his book  
*A Whole New Mind, Moving from the information  
age to the conceptual age*

describing a seismic change in the advanced  
world from an economy and a society built on a  
linear, logical, computer-like Information Age to  
one built on the inventive, empathetic, big-  
picture Conceptual Age.

The features of this are more “right brain” than  
left, and similar to  
chaos and complexity science.

Education of the heart is the Japanese  
Education Ministry term for encouraging greater  
creativity, artistry and play in learning, and  
encouraging students to reflect on meaning and  
mission in their lives.

A tsunami change in thinking from the rigid rote  
learning. This new kind of thinking worldwide  
would support global heart and sustain the  
global heart emerging.

*“The heart has its reasons which reason does not understand”*  
Pascal

# HEART

*The Heart Mantra: The essence of Buddhist teachings*

*The mantra that calms all suffering*

***Om gate gate paragate parasamgate bodhi svaha.***

*“Gone, gone, gone all the way over, everyone gone to the other shore, enlightenment, Welcome”*

...the great mantra of prajnaparamita,  
the mantra of great insight,  
the unsurpassed mantra,  
the unequaled mantra,

[http://reluctant-messenger.com/heart\\_sutra.htm](http://reluctant-messenger.com/heart_sutra.htm)

also in the book “Heart” by Gail Godwin

The Heart Mantra is the best way to begin this book and meditation on heart, the Indian Ocean tsunami and chaos: thoughts for those lost, for the survivors and ourselves lost in thought, and for rethinking chaos and the world.

Much of the day to day life of the areas affected most by the tsunami - Indonesia, Sri Lanka, South India and Thailand is influenced heavily by Buddhist teachings.

The heart mantra is universal, used by the people of the region to calm their suffering. It is something we can share, even at a distance, as was done by Rev Yen Jen Sik at The Scarborough Hospital Tsunami Heart Valentine’s event for 2005.

*Sharing is so important that the Venerable Thich Nguyen Thao, Buddhist Master of a small BC Canada temple said when donating a temple worth \$500,000 to the Red Cross for tsunami relief “I feel we can share a little bit of suffering with them...”*

## HEART

The heart shape we know and use in drawings and on Valentines looks only roughly like the real heart. Gail Godwin, in her book *Heart*, implies a fractal nature of heart, with each person's heart drawing different, depicting personality, but each still heart shaped.

The heart shape we use seems to have unusual origins. Godwin mentions that mythologists think that the heart symbol we use evolved from the ivy leaf, the symbol of immortality in ancient times, becoming a symbol for friendship and fidelity later.

She feels however that our heart symbol may go back even to prehistoric times, with a red heart shaped spot where the heart should be found on the image of a woolly mammoth painted on the wall of the Pindal cave in the Asturias of Spain.

The word *heart* was recorded as far back as Sumeria in 1850 BC, written all over clay tablets in one of the first stories ever told, and with a dual meaning even then, as both the organ that sustains life and the "wellspring of our emotions" For much more detail on anything heart, please read the book *Heart* by Godwin.

# HEART just plain heart

Gail Godwin's book

*Heart: A personal journey through its myths and meanings* (William Morrow 2001) takes us through the various meanings of heart, ending her book with the Buddhist Heart Mantra.

This book began there, in tribute to all those touched or involved with the tsunami or gone, gone all the way over, gone to the other shore.

The sacred Hindu text, the Upanishads, describe the heart as “the fulcrum of the cosmos.” We recognize the heart as the center of everything. Thinking, caring, concern, sharing, compassion, are all matters of heart. To have a heart means to look beyond our personal situation and needs to the interests of others, to consider and to make some one else happy. Heart-felt actions come from deep within, and even small sacrifices by us can make a big difference to others and to the world, an essential feature also of the news chaos.

Previous writing and thinking on heart, cosmos, chaos and complexity, tsunami and South Asian Heart by this writer, all elements of the recent tsunami, are brought together in this book, to reflect on the communal heart of the world and the individual hearts of everyone and every group, who in their own way were touched by the tsunami and became involved.

It also discusses the need for and the emergence of a re-thinking of the world, after the tsunami chaos and tsunami heart, to a global heart that will beat long after the tsunami is gone.

## Tsunami Heart

We have all been touched by the tsunami. The outpouring of concern and support from everywhere is like a global heart at work, defining our humanity, establishing our ability to become involved at times of need. This needs to be sustained with the development of a global heart for all times.

The Jesuit scientist Pierre Teilhard de Chardin (1881-1955) writes in his autobiography of the convergence of hearts, describing a “thinking envelope” of the world, (Noosphere) that evolves with our increasing numbers and complexity to a world heart. This heart of the world has become more evident now in response to the tsunami.

For those directly affected by this disaster, the heart of the world bleeds and wishes to do more. For those of us touched further away, we feel more strongly the interconnectedness of the world we live in and wish to be involved. Having revealed this care and concern, we should sustain it beyond disasters. The images may recede, the emotions fade, but the connectedness and the other problems remain.

***We have moved from the global village to a fractal world***, living at the heart and the edge of everything, being part and whole, diverse and entire, all at the same time. This is the essence of the term *fractal* taken from chaos theory, which provides new meanings, models and metaphors for life, including the interconnectedness of everything.

We are all involved. There are enough other places and other events locally and globally to keep us connected.

Out of the tsunami chaos and heart now emerges a fractal global heart in a fractal world that keeps us connected.

# Heartbreak

Why?

There are no answers, only questions.

This tsunami of 2004 is gone,  
but its effects will linger long  
and change the world forever

The overwhelming support  
from around the world  
will now be harnessed  
for lasting change.

The terms used  
*unprecedented*  
*unimaginable*

make you rethink  
what life is all about

Heart. Just heart

From tsunami heart to global heart

***Everything touches the heart***

# Heart

As a cardiologist I try to keep hearts beating longer and better. But the word *heart* means more to me than preventing and treating heart disease. *Heart* is caring and sharing as described in this book, which suggests ways we can keep the global heart beating longer and better. Here are some other of my writings on heart.

***Jurassic Heart: From the heart to the edge of chaos:*** an invited commentary in the *Canadian Journal of Cardiology* 1993. The editor, Dr Robert Beamish, had just returned from a conference on consciousness in Arizona and had read about chaos and complexity. I had previously submitted a letter to the editor on chaos in the coronary, suggesting the importance of such ideas in heart attacks, which was published with an accompanying editorial by him, followed by my more general commentary.

***Ethnocultural Heart: another challenge for an emerging diversity:*** invited commentary, *Canadian Journal Cardiology* 1995. Dr Beamish had become aware of my increasing work on ethnicity and heart health and especially on heart disease in South Asians from the late 1980's. This was the introduction of these concepts to heart health in Canada, and it was considered very controversial, and unacceptable then, but has become leading edge and necessary research now. I wrote the commentary from the perspective of complexity, which is the natural way to explore this now, but this also was not acceptable thinking then. The manuscript was accepted only after all vestiges of complexity were removed, having gone through the peer review process. The complex dynamics of ethnicity or diversity and health are now central to any such current discussion.

***Heart at 2000: new meanings, models and metaphors for a new millennium.*** A 2000 word essay on chaos and complexity as applied to heart, following mathematician and historian Ralph Abraham's contention that three streams of history - Chaos, Gaia and Eros converge again around 2000 after many centuries.

“It reminded me of Niagara Falls.”

Depak Jain, Dean of Northwestern University’s Kellogg School of Management, who was in Phuket at the time of the tsunami, after teaching at Bangkok.

*Waves as high as 30 meters (about 90 feet) were observed.*

“horror” and “unprecedented disaster” brought home to us  
real time. Never forget.  
The world changed for many of us that day.

# TSUNAMI

Please search web for

*Tsunami South Asian tsunami* or other key words to see video or still images of the tsunami or read descriptions or *Wikipedia tsunami* for details and extensive links or

<http://iri.columbia.edu/~lareef/tsunami/>  
for scientific background and animation

<http://www.pbs.org/wnet/savageearth/animations/tsunami/>  
for Savage Earth animation

[http://www.pbase.com/issels/phuket\\_tsunami&page=all](http://www.pbase.com/issels/phuket_tsunami&page=all)  
for graphic slide show

<http://homepage.mac.com/demark/tsunami/>  
to toggle between before and after pictures

<http://edition.cnn.com/SPECIALS/2004/tsunami.disaster/children/>  
CNN coverage about the children

## Tsunami: the simple

The simple: Earthquakes at the bottom of the ocean, volcanoes pouring lava or mudslides into the ocean displace water which become waves that travel across the ocean, rising much higher in shallow waters close to shore, destroying everything in their path.

*A magnitude 9 earthquake occurred December 26, 2004 causing the Indian Ocean tsunami. An aftershock magnitude 8.7 earthquake on March 28, 2005, with epicenter not far away, raised fears about another tsunami, which never materialized. Why does one earthquake cause a tsunami when another from a nearby location and a bit similar does not? This is an important question, with implications about when to advise evacuation to higher ground, which carries its own challenges and concerns.*

*Whether tsunamis form after earthquakes depends on the area of the seafloor affected, the volume of water displaced and other factors. The earlier was in deeper water (1000 –2000 meters vs 100-200) with the ocean floor heaving over 240,000 sq km vs 30,000 in the second. The vertical movement of water was much larger and over a much larger expanse in the tsunami earthquake.*

*The highest wave in the first was 30 meters (90 feet) and in the second, barely 30 centimeters, measured in Oman.*

*Hiroshi Ueno, from the Earthquake and Tsunami Observation Division in Japan, said, “It just shows how difficult it is to predict tsunamis. It is not an exact science...”*

## Tsunami: the Complex:

Tsunamis are coherent waves like solitons, with little dissipation of energy until reaching shore, exhibiting features of new or scientific chaos. Not all earthquakes produce tsunamis and not all tsunamis start as earthquakes.

Chris Chapman, Professor of Geophysics at Schlumberger Cambridge Research was at the beach in Sri Lanka when the tsunami struck. His story and images of the beach are described at: <http://149.166.110.235/geosrilanka/stories/Personal%20Experience.htm> The addendum at this webpage or at American Geophysical Union [http://www.agu.org/eos\\_elec/000929e1.html](http://www.agu.org/eos_elec/000929e1.html) describes the mathematics

The basic theory for the propagation of the tsunami has been given by *Jeffreys and Jeffreys* [1962, section 17.09) in an analysis of the dispersion of gravity water waves in a flat ocean of constant depth. In terms of a dimensionless frequency,  $\Omega = \omega(d/g)^{1/2}$ , where  $d$  is the water depth,  $g$  is the gravitational acceleration, and  $\omega$  is the angular frequency, and a dimensionless wave number,  $K = kd$ , where  $k$  is the wave number, and the dispersion relationship for gravity water waves is

$$\Omega^2 = K \tanh K.$$

In fact, for tsunamis we only need the long-wavelength limit,  $K \ll 1$ , when the phase and group velocities can be approximated by the quadratic term; i.e., for dimensionless velocities, these are

$$\begin{aligned} C &= c/(gd)^{1/2} = 1 - K^2/6 \\ V &= v/(gd)^{1/2} = 1 - K^2/2, \end{aligned}$$

respectively. Then a wave number integral can be evaluated using the Airy function to give the wave displacement in the form of the so-called Jeffreys phase [Bullen and Bolt, 1985]

$$u = \frac{2\pi}{(T/2)^{1/3}} \text{Ai} \left( \frac{X - T}{(T/2)^{1/3}} \right)$$

I would not for a moment pretend to understand such math and physics. But for a twist of fate, I may have been writing such equations. I was initially destined to be a physicist and would have understood such things. At university I switched to medicine however making the above equations as unintelligible to me as the complexities of medicine would be to a physicist.

This digression illustrates a feature of chaos theory popularized as the Butterfly Effect, where a butterfly flapping its wings in Brazil causes a tornado in Texas, showing the possible later implications of small changes in complex systems. The movie “The Beach” filmed in Phi Phi, Thailand, one of the tsunami’s worst-hit resorts is said to illustrate features of this as well.

The math and physics of tsunamis are important and have more universal appeal. I wrote about coherence and solitons in *Chaos from Cos to Cosmos: Making a New Medicine for a New Millennium*, suggesting a quantum chaos coherence theory for brain function, with waves traveling like tsunamis.

Perhaps it is this tsunami-like activity in the brain that make us think, rethink and act, responding to events like the tsunami, and everything else. This would be a major change in thinking about the microscopic to the cosmic, from chaos to cosmos.

## Tsunami: the soliton

The same math and physics of solitons that make tsunamis peculiar and dangerous find everyday usage now. Essentially what the math says is that there are two kinds of waves, low and high amplitude. All else being equal, low amplitude waves, like ripples in a pond after a pebble is dropped, have low energy and behave linearly with the component frequencies separating as the ripples we see, and the waves fade out. High amplitude waves have high energy, behave nonlinearly and tend to compress, creating turbulence as white water, before collapsing at the edge (of chaos).

In very *unusual situations*, the dissipation of energy cancels the compression allowing a wave to travel long distances without losing much energy, such as tsunamis that maintain waveform across an ocean. Hence a tsunami outside Sumatra will travel all the way to India and even to Africa at jet plane speed, with still enough energy to crash on shore causing destruction.

Solitons were first described by Scott Russell in 1834 as he was riding along the Union canal in Scotland on horseback, following the wave for miles. Heriot Watt University in Edinburgh has a website <http://www.ma.hw.ac.uk/math.html> on *solitons* in his honor, and Kyoto university has a permanent exhibition with a web site. 150 years later, his discovery is widely used, in the billions of *solitons surging tsunami like in the fiber optic networks of cable TV, phone lines and internet we use everyday.*

There is even a body of thought that similar solitons exist at various levels of our biology, from DNA structure and intracellular organization to electrical waveform generation in heart and brain waves. Tsunami effects exist far beyond the ocean.

## Why? Tsunami: an act of God?

The natural and difficult question is why the tsunami and why would God allow such devastation, suffering and loss of lives. For believers in a personal and all-powerful God, such disasters can either test or strengthen belief and faith.

Tsunamis are called acts of God, and have been considered God's response to man's wrongdoings. Michael Valpy (Globe and Mail Jan 8, 2004) tells us of the Lisbon earthquake and tsunami of 1755 killing 60,000 people, after which priests hung persons thought to be responsible for the devastation [caused] by angering God, as also happened 1200 years earlier with Constantinople.

Valpy also quotes Israel's Sephardic chief rabbi Schlomo Amar on tsunami as "an expression of God's great ire with the world –the world is being punished for wrong doing," Iqbal Sacranie, secretary general of the Muslim Council of Britain, "This is the will of God Almighty" and Rev Phillip Jensen, Anglican dean of Sydney, Australia, "Disasters are part of [God's] warning that judgment is coming."

Valpy further says that "the theological defense of God at these moments is called a *theodicy* – the attempt to justify belief in the goodness of God in the midst of evil and suffering" and quotes Douglas Farrow, Professor of Christian thought at McGill University as saying that the argument that God is delivering judgment on the wicked "doesn't work well with natural disasters."

Muslim acceptance of God's will is illustrated in the statement *Inshallah* (God willing) when planning things, suggesting the possibility that things may change by God's actions. Whether good or bad, they are all accepted as God's will.

Valpy quotes Toronto's Roman Catholic Cardinal Aloysius Ambrosia however as saying "God is an intensely personal being and an intensely mysterious being...[and] the earth operates according to the laws God gives. Even [tectonic] plates have laws."

Tsunamis are not random or chance. There are laws that make them happen.

## Tsunami: religion versus science

The question of why would God allow a tsunami that causes such destruction challenges understanding for philosophers and scientists and either tests or reaffirms the faith of anyone of religion.

The fallout after the Lisbon earthquake of 1755, where 60,000 people died, sent thinkers like Voltaire to secularism. He asked in a poem, what universal good could be seen in “infants crushed upon their mothers’ breasts” and the dying “sad inhabitants of distant shores.”

Dr Bhudendra Doobay, Hindu priest and community leader as well as heart surgeon, thus religionist and scientist, answered the question of why, during a TV tsunami relief fundraising appeal. Lamenting the fact that innocent children lost their lives, he stated that God is responsible for everything, both the good and the bad, and that the universe is unfolding with an order and plan.

He feels that we must accept the nature and details of this unfolding, whatever it brings, and strive as much as we can to help those suffering.

Ari Afrizal, the 21 year old carpenter who spent 15 days adrift in the ocean after the tsunami, agrees, saying “The heat comes from God. The cold comes from God. Death and life also comes from God” (Toronto Star, Jan 12, 2005).”

Religion and science do not clash here, being separate, relating to different domains. Reeves, de Rosnay, Coppens and Simonnet write in “Origins: Cosmos, Earth, and Mankind” that science and religion have different approaches to the mysteries of the universe, that science seeks to understand the world while religion tries to give life meaning, and that “they can shed light on the other, but only so long as they both remain in their own territory.”

We all recognize chaos and order intertwined in the universe. Tsunamis, natural and social disasters and widening disparities challenge our understanding, and now even moreso, drive us to rethinking our world.

## Tsunamis and the laws of nature

Tsunamis and other disasters follow the laws of nature. For believers, these laws are given by God and we could presume that God acts through these laws.

For those who do not believe in God, the laws of nature just exist, and things just happen. Science explains how and also why, describing the mechanism and not the reason. A middle ground is that there are mysteries beyond the laws of nature that we do not understand, but do not wish to explain as actions of a god.

The new science of chaos and complexity essentially provides new laws of nature - or the governing dynamics for complex situations, with ever-changing interactions between parts, or complex and nonlinear dynamics. It thus extends the laws of nature to the unexpected and unpredictable in natural and other disasters and even complex social situations.

Thus, for anyone believing in a personal God, one can say that God works through chaos, and for others, chaos just happens, as the nature of complex dynamic interactions.

Myriads of interacting influences contribute to the tectonic plates slipping at that time and place, causing the sea to rise unexpectedly and start the tsunami. A peculiarity of these same laws of complex systems allows the wave to travel long distances without losing energy (soliton and coherence) before crashing on shore. The same laws of complex interacting systems come into play in the ensuing chaos as well as the complexities involved in the relief efforts.

***We should rethink tsunamis, natural and other disasters and the ensuing complexities from this new perspective.***

The South Asian Tsunami of December 2004 led to significant rethinking. It has become a metaphor for change and even for rethinking.

Barry Bloom, Dean of the Harvard School of Public Health, writing in the September 2005 Special issue of *Scientific American* "Crossroads for Planet Earth: a plan for a bright future" describes the lack of public health systems on a global scale, saying "the tsunami of 2004 brought this to light in a most vivid way." He expressed concern about the lack of central authority to turn to when government and international relief agencies jumped in immediately after, with "no infrastructure to handle a disaster of such international dimensions...." Reflecting on this, he proposes that, "the world needs an infrastructure that enables decision makers to address health, economics, the environment and national security in an integrated way."

In arguing for prevention and public health interventions, Barry Bloom also invoked the 2004 Tsunami, using the example of public health officials setting realistic goals and coordinating relief efforts after, thwarting the spread of cholera, measles and dysentery expected.

Out of the chaos of the tsunami and the complex dynamics of the social, economic and health and other systems involved, arose opportunities for reflection, rethinking and change. The tsunami provides us an opportunity to explore further the world of chaos and complexity, and how to use it to create change.

*“To see the world in a grain of sand,  
and heaven in a wild flower,  
to hold infinity in the palm of your hand,  
and eternity in an hour.”*

**William Blake**

***Chaos is not a free for all***, does not mean that anything can happen and can not be used to explain the impossible.

Chaos ***does mean*** that ***anything that is possible*** could happen if certain conditions exist.

Sudden and unexpected things do happen, but only from the realm of the possible.

Chaos obeys all the laws of physics and is rooted in math and physics.

Chaos only supports whatever serious physics and math supports.

Physics describes the very small (atomic level) and the very large (cosmic) very well, and also interactions of small number of objects. It has trouble describing the complex interactions at human scale and the behavior of the irregular and turbulent.

Chaos describes these much better, such as the multilayered complex everchanging interactions with constant feedback and change or adaptation, like webs, ecosystems, waterfalls, ocean waves, changes in society, communication, organization, politics, peace, etc .

# CHAOS

*Chaos* is the quantitative study - the math and science of complex phenomena, with observations and new thinking on how the world works.

*Complexity* is the qualitative use of the new meanings, models and metaphors that come from chaos, to describe, explain and change the world.

## Chaos is

A new science that better explains the irregular and uncertain and of

- the dynamic balance of order and disorder.
- how the world works and how things happen.
- patterns in apparent randomness or disorder.
- limitations to knowledge.
- major changes from small efforts (in complex systems)

## Definitions of *chaos and complexity*

*Usual chaos*: as confusion or disorder.

*Old chaos*: Mythological, the origin of everything

*New chaos*: scientific, as order and disorder intertwined.

Scientists and mathematicians use it quantitatively, others mostly qualitatively and descriptively. Many scientists and mathematicians do not accept or agree with this “misuse” of the term *chaos*, but others find it useful.

The new science of chaos began in 1975 with Tien Yien

Li and James Yorke’s math paper

“Period three implies chaos,” which led to

*chaos theory*, used mostly as order into disorder *and complexity* as disorder into order, or self organizing in complex systems with emergence of novel or different phenomena not predictable from the constituent parts.

*Complexity* is also used as the qualitative or descriptive aspects of chaos (order and disorder intertwined) to distinguish the ideas from real scientific or *deterministic chaos* as the quantitative aspects of chaos (order and disorder intertwined) with equations etc.

*Chaos, for me* is all ideas that emerge from chaos theory, qualitative and quantitative - order and disorder intertwined, with the words *chaos and complexity* thus used interchangeably.

## The spread of chaos

Chaos started as math and physics. Then it went out into the world, popularized mostly by James Gleick's 1987 book *Chaos: Making a New Science*. It soon became unpopular, considered of limited use, since its mirror image, complexity, or the development of order found more widespread applications.

This is probably because James Gleick's book focused more on the disorder part of chaos, the term chaos sounds like it means disorder, and not as many people read *Turbulent Mirror* by John Briggs and F David Peat or *Fractals: the patterns of chaos: a new aesthetic of art, science and nature*, by John Briggs, which described chaos as both order and disorder intertwined.

Scientists mostly started using these ideas in the 1980's and social scientists in the 1990's. From 2000 or so, the concepts have become commonplace and used everywhere.

Our experience began around 1990, sensing in James Gleick's book, the potential for more widespread use. Since the early 1990's we have published and discussed widely the applications of chaos and complexity in nursing, medicine, health, society, peace, development, ecosystems, and consider it applicable to essentially everything - life, the universe and everything else, as depicted in the title of an earlier book - *CHAOS: From Cos to Cosmos*.

## Chaos - not just complexity

I think there is *still a lot of merit using the term chaos*. It captures the imagination. It seems much more appealing and accurate than *complexity* in describing some of the things we experience. For instance, the sudden rupture of a plaque in an artery causing a heart attack with a risk of death is essentially self-criticality, with self-organization from the complex, nonlinear and dynamic interactions of numerous systems and interactions with multiple levels of feedback and change or adaptation.

These include: the systems that allow blood to form clots, the system that dissolves clots, genes, the biological and social things that make cholesterol levels high, and everything else. This is complexity for the person using a qualitative description. But there is an underlying math and physics that lead to this, and to everything else in the universe, which is chaos.

The word *chaos* is thus not only scientifically accurate but evokes the appropriate imagery of the sudden and abrupt nature of the event and its antecedent causes as well as consequences.

The same applies to everything else, to a greater or lesser degree, all chaos or all complexity, if we wish to use this more acceptable terminology, or as I use the terms, all *chaos and complexity*.

The terms used can be confusing: ***The ideas however are intuitive***. They simply reflect the rules that govern how and why things happen. The multiple interactions make things complex, but simplicity can arise from this complexity and complexity can result from simplicity. They reside within each other.

## Chaos as order: hidden subtle order

John Briggs has written what I consider the most beautiful book on chaos and fractals. It is a pictorial and narrative in large format style with large format ideas simply described. After all he is a Professor of English, with a sense for beauty. The following is an illustration of his deep understanding of chaos, as an aesthetic of art, science and nature, the subtitle of his book *Fractals: the Patterns of Chaos*.

*“Chaos theory and fractal geometry extend science’s ability to do what it has always done: find order beneath confusion. However the order of chaos imposes a definite limit on our ability. With the use of computers, scientists can see chaos, can understand its laws, but ultimately can’t predict or exert control over it. The uncertainty built into chaos theory and fractal geometry echoes two earlier scientific discoveries of this [20<sup>th</sup>] century: the fundamental uncertainty that Gödel’s theorem found skulking inside mathematics and the array of essential atomic uncertainties and paradoxes unearthed by quantum mechanics. Science, in this century, seems destined to learn about nature’s intention to remain behind a veil, always slipping just beyond our understanding, imposing a subtle order.”*

John Briggs in *Fractals: The Patterns of Chaos: discovering a new aesthetic of art, science and nature*.

## The simple and the complex

### CHAOS

*math, physics , science and philosophy of  
Order and disorder intertwined in the  
universe.*

*or*

**Complexity** *Hidden* **Amidst** **Observed**  
**Simplicity**  
*and the reverse*  
*Simplicity Observed Amidst Hidden*  
*Complexity.*

### COMPLEXITY

*The science of complex things: arises from  
chaos theory.*

We need to learn about **complexity**,  
the science of complex things,  
to deal with the things we call **complex**.  
But complex is different from complicated.

**Complex:** *many interacting parts with multilevel feedback, and change: like ecosystems and most things in life, nature and society.*

**Complicated:** *containing many parts, like machines.*

**Complex:** *most world problems, war, peace, poverty, etc and most diseases and global health concerns, diabetes, heart disease, AIDS, etc.*

**Complexity:** *the science of things complex.*

*The very new science of chaos and complexity provides us with the understanding and the tools to better deal with the **increasing complexity of 21st century problems.***

*This is a **unique opportunity, which comes only every few hundred years**, where the need for a new thinking coincides with the availability of a new science.*

Ideas similar to those of chaos and complexity science have **spontaneously emerged** in and across many disciplines, as a result of trial and error, intuition, experience and adaptation, as better solutions to 21<sup>st</sup> century problems.

Chaos and complexity science provides a scientific framework to understand previous failures or limitations, and consequently to guide practice and change at all levels, from strategy and policy to the delivery and practice of health and everything else.

## Chaos and complexity science

- *discovered 1975: has entered global culture: describes and shapes our reality*
- *mathematically based: describes “governing dynamics” - how things happen*
- *2003 Japan Prize in Science and Technology: fractals and chaos as universal structures of nature.*
- *science of complex dynamic adaptive biological and social systems and processes, like networks, ecosystems, etc*
  - *basic science for natural science*
- *science of social, economic, political, cultural, religious and other systems that impact peace,*
- *nonlinear dynamic interactions at multiple levels and varying degrees with feedback, adaptation and change (iterations), potentially influencing everything*
- *new management, organizational and leadership science*
- *new theory for medicine, health and disease, life, the universe and everything else*
- *self-organizing principle of global heart emerging after the tsunami*
  - *tool for change*

*Features of chaos and complexity:*

- multiple perspectives
- inherent uncertainty and surprise
- interconnectedness
- self-organization and emergence or “order for free”
- sensitive dependence - small inputs can dramatically change outcomes

*Derived features of chaos and complexity*

- *fractal* patterns of self similarity with differences
- *strange attractors*: “strange” predictability - outlines set - uncertain details
- *The Butterfly Effect* - a butterfly flapping its wings in Brazil causing a tornado in Texas (sensitive dependence)

Strange attractors are the patterns or outcomes to which complex systems are attracted. The concept could be used for risk factors, eg. for heart disease. People with a certain pattern of risks are attracted towards a pattern of illness with uncertain details. The patterns they are pulled to will change if risk factors are modified, possibly all the way to good health

from previous writing on health:  
*A New Chaos Based Medicine: 2000*

Current applications of  
chaos and complexity in  
health

- Leadership
- Organizational
- Management
- Policy
- Strategy
- Diversity
- Ethnic Populations
- Hospitals
- Health care organizations
- Health care institutions
- Local and National
- Health Promotion

Other applications with  
direct or indirect impact on  
health

- Global warming
- Sustainability
- Development
- Economics
- Governance
- Democracy
- Ecosystems
- Poverty, war, famine
- Peace and conflict
- Population growth,
- Global diseases,  
AIDS, malaria,  
SARS, etc

## Chaos of nature (usual and new)

Stephen L Harris begins his book - *Agents of Chaos* (written before chaos science) with these thoughts:

*“A clear day, predicted to be sunny and calm, suddenly turns cloudy and thunderous. The heart of a previously healthy runner abruptly flutters and stops.... Without warning. The seemingly solid earth beneath our feet begins to heave and roll like a sea in a storm, toppling buildings and killing thousands of people.*

*“These unexpected disruptions of the normal order are manifestations of chaos, the sudden injection of violent change into a previously stable environment or system. As scientists are increasingly aware, chaos plays a major and, as yet, an entirely unpredictable role in geologic processes and human lives.*

Harris describes the reality of chaos in day to day living, with sudden disruption, randomness and confusion as part of the new scientific chaos. Since its technical description in 1975, scientific chaos also applies to all of the kinds of usual chaos described above, where there is some order in the apparent disorder, some determinism and with a strange but not complete predictability.

Harris writes that chaos permeates the very fabric of the universe, from stockmarkets and sub atomic particles, to earthquakes and volcanic eruptions.

This new science of chaos, and the related field of complexity, have their own new rules and features, which can describe and explain turbulence and the irregular as well as the predictable in the real world, better than classical science does.

## Chaos as science (new chaos)

Before chaos and complexity (1975), science had three theories to explain how the world works, according to Barry Parker in *Chaos in the Cosmos: The Stunning Complexity of the Universe*.

- 1) ***Newton's laws or classical mechanics*** describes simple systems with only a few objects that matter. This system is deterministic, the past determining the future, is predictable and outcomes easily calculated.
- 2) ***Statistical mechanics***, based on probability theory, describes complex systems: like the molecules in a gas – each too complex to be truly deterministic and predictable. Best described using averages.
- 3) ***Quantum mechanics*** from the 1920's, also based on probabilities as a probability wave applied only to the atomic world.

***None of these theories can describe the complexities of everyday life***, the apparent simple things in nature like drifting clouds, leaves falling off a tree or floating in a river or turbulent events like waterfalls, earthquakes or tsunamis.

Chaos and complexity science, which, with quantum physics and relativity are considered the three most important advances in science in the last century, explains not only these natural phenomena, but similar complex systems in a wide variety of fields, from biological to social, economic, political, business, management and organizational systems.

Chaos and complexity is also the scientific basis for the ecosystem thinking of the 1980's with its organic web-like model of the complex dynamic interactions observed in such systems.

### ***More precise and technical chaos and complexity.***

Michael Barranger at the Center for Theoretical physics at MIT says that twentieth-century theoretical physics came out of the relativistic revolution and the quantum mechanical revolution, and that it was all about simplicity and continuity, with its principal tool calculus (search internet for article Chaos, complexity and entropy: a physics talk for non physicists).

He says that ***21st century theoretical physics is coming out of the chaos revolution*** and it will be about complexity and its principal tool the computer.

Baranger further says that chaos is a purely mathematical concept and is an undeniable mathematical fact, and that since theoretical physics is based on mathematics, all theoretical physicists are applied mathematicians. He says that physicists became occupied with relativity and quantum mechanics rooted in the very successful calculus, which led to that century's reductionist thinking - the belief that absolute control arises from detailed knowledge, and that chaos is the anti-calculus revolution. It describes the irregular and uncertain.

He says that chaos (real or deterministic chaos) is a small subfield of the much larger field of complexity, and that complexity implies the presence of chaos (but not the reverse), since all nonlinear systems are chaotic at some time and chaos and complexity share the condition of nonlinearity. ***Chaos***, he considered basically ***pure mathematics*** and ***complexity*** not really math but more like ***theoretical physics or theoretical anything***.

Complexity is considered an interplay between deterministic chaos and non-chaos or the ***edge of chaos***, and involves the interplay between cooperation and competition, which leads to evolution. It must include many interdependent constituents interacting nonlinearly. Emergence of new properties not predictable from knowledge of the constituent parts is a feature of complexity, and self-organization arises from the emergence. The interplay of competition and cooperation keeps biological and social systems like families, cities, communities, cultural groups, nations, etc. poised at the edge of chaos for survival advantage, as the new version of survival of the fittest. Fittest here is being at the best place in a fitness to survive and thrive landscape.

## New or scientific chaos

There are two kinds of descriptions of chaos in everyday writing and thinking, with a third, which is mythological, not often used. The first is the chaos that simply means confusion and disorder, from things close to home such as bad traffic or bad weather causing disruptions, and everything going crazy at home or work, from rushing or stress to more catastrophic events like wars and disasters.

The new chaos is a scientific concept with a mathematical base showing such chaos as disorder intertwined at various levels and magnitude with order throughout the universe and in everything we do. These overlap with the confusion type of chaos having within it some degree of order, and order having some degree of chaos as well.

It is like a tapestry of life and the universe woven together with intertwined chaos and order. The term fractal describes the feature of this, with things appearing a bit similar but with some difference at different levels within the intertwining.

There is nothing new about the new scientific chaos, described only since 1975 in a mathematical journal. Although it has now been applied extensively and used as a tool for change across many disciplines, the ideas go back to ancient civilizations, religions and philosophies, and much of its concepts now appear self-evident and like common sense.

What's new is that there is now a scientific base with simple equations, which yield new meanings, models and metaphors as well as vivid computer generated images to aid understanding and allow study.

The ideas of chaos have spontaneously emerged in society, from observations and thinking about reality, without the need to learn the math or physics. Most people feel it, live in it and practice it without knowing or calling it chaos.

# The history and future of chaos

From *Chaos 2000: From Cos to Cosmos: Making a New Medicine*.

**Chaos is not new.** It is as old as the mountains and the streams. It features in the creation myths of many cultures as the origin of everything. Chaos has waxed and waned over history and prehistory, **is enshrined in the religion, culture and philosophy of various civilizations**. It is now **emerging again, this time as a science**, sparked by the computer revolution of the late 1990's, applicable to the physical, biological and social sciences, becoming the science of everything, and of the future.

Chaos is an abstract cosmic principle, referring to the source of all creation, according to Ralph Abraham in *Chaos Gaia Eros*. Chaos is a void, out of which everything arose in Greek mythology, recorded in the *Theogony* by Hesiod, one of the early Greek poets.

Out of Chaos arose Gaia, the created universe, and Eros, the creative impulse.

This same trinity, according to Abraham, preceded the creation of the gods and goddesses of the usual pantheon of early Greek paganism (also called Orphism), and is associated with **three current revolutionary movements in the sciences**, all sharing a similar **mathematical basis**.

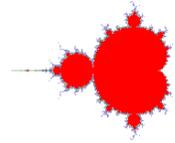
**Chaos revolution 1975:** for a mathematics of irregularity

**Gaia Hypothesis 1973:** earth as a living ecosystem.

**Erodynamics 1989:** dynamical systems to social phenomena.

**2000 - the chaos epoch:** the above three are converging now, with widespread applications to almost everything.

## Fractals: the patterns of chaos



This is a computer generated Mandelbrot set fractal. Magnifying any part reveals a similar pattern to this image, *self similar*, but not entirely exact. A more complex looking fractal shows the dynamics or ever changing nature of the image, but still keeping the basic shape, with a different kind of differences, always a part and the whole at the same time, *diverse and entire*. Thus fractals exist between dimensions, allowing us to see not only infinity, but multiple infinities everywhere. Zooming in anywhere in such computer images reveals self similar yet a bit different patterns.

Much of the patterns of nature appear like this: from the branching of ferns, rivers, mountain ranges, ice crystals, snowflakes, waterfalls and currents to clustering of stars and galaxies. Fractal patterns have been observed all the way from the smallest particles in a cell, through DNA, microscopic structures and branching of the arteries to larger scale patterns across the planet and the cosmos.

Beyond the observations of physical structures, such patterns have been observed in poetry, historical thought, communication, rise and fall of civilizations, social and economic organization, ecosystems and essentially probably everywhere.

***Fractals are considered fundamental structures of nature and probably life, the universe, organization and everything else.***

## Fractal global heart and fractal thinking

*Fractals* represent the patterns of chaos - the science of complex adaptive systems like ecosystems, with novel function and relationships, which provide a model for our interactions with each other, individually or in groups.

*Such systems* display nonlinear dynamics with strong and weak interconnections and interdependencies, balancing cooperation and competition at multiple levels, with sensitive dependence or the power of small inputs to change outcomes.

*They illustrate* our interconnectedness, interdependence, our web-like environment, and the power of small changes locally and globally to shape our shared future.

*The global heart emerging displays such fractal patterns.*

Globally there is the emergence of support, which has patterns of variations in degree and not entirely homogenous. Within each country or community there is a similar pattern down to the smallest level of organization, perhaps a small group in a school or an office. The patterns are similar and everchanging. The support is both whole and fragmented at the same time. Similar patterns exist across geographic boundaries through connections, organizations, etc, with a similar fractal distribution

*Global thinking is similarly fractal.* It is clearly not homogenous. There are patterns of thinking within each community and country that change with circumstance and influences. These track across all boundaries to show a similar thinking in subsets but with local variations, everchanging, and with complex dynamics.

## A chaos thinking: beyond the simple and the complex.

Have you ever thought about *why we think the way we do*, and how events and other influences change our thinking? There is a simple and a complex here. We just think about something and say it. But where does that thought come from. How many things have been integrated into causing that thought in that particular form? And what could have made it different. And after it is formed and registered, how does it change.

Undoubtedly there are countless influences, current and past, drawing glimmers from every previous conversation and previous thought, influenced by immediate circumstances and new and old information as well, all constantly changing, that lead us to opinions and behavior. It would make sense that the rules of chaos and complexity govern how this happens, explaining bifurcations, sudden change of heart or mind, sensitivities to certain things, and all our varied consistent and sometimes inconsistent responses and reactions.

The presence of chaos in such a complex thing as the brain and the complex processes emerging as the mind would not be surprising. There are billions of billions of interactions occurring all the time, with quantum leaps of imagination cavorting inside our heads. These obey the laws of nature, which used to be Newton's laws, but more recently have become, because of their complexity the new laws of chaos and complexity.

This may help us to better explain how and why expected and unexpected things happen and how to influence thinking, locally and globally. It would explain the idea of "idea viruses," which when planted, travel widely, self-organizing to change thinking. It would explain tipping points and the emergence of changing collective thinking.

***It would explain the sudden and unprecedented outpouring of support after the tsunami as a global heart beating, and hopefully guide us to sustain such thinking for continuing concerns.***

## Fractal thinking: beyond the simple and the complex.

**How** we think is complex - numerous linear and nonlinear, recent and remote, local and distant interactions leading to an outcome. **Why** we think what we think is the result of all those unseen interactions.

**What** we think, or what we express as what we think is also complex and fractal. It has texture and is multilayered, rooted in its past complex interactions. We may have an overall opinion on something, but when examined in detail, like zooming in on a computer image of a fractal, we may see the components of that thinking arranged according to the rules of chaos, and subject to sensitive dependence, illustrating differences at different scales.

Our support for the tsunami may be fractal. A single thought expressed is not just a simple thought. It has its multiple layers reflecting its complex origins, and sensitive dependence may lead to a changed thinking after its expression. Our expression of support bears the marks of its constituent influences and mini-thoughts that led to the overall and emergent of the thought that is expressed. It has components of support and not support within each other. Engaging in discourse exposes this textured thinking to the potential for change upon interaction with other and newer influences.

A new fractal thinking may thus be a novel way to express, understand and influence thinking and thus to achieve desired change.

## Fractal thinking and changing the world.

Our thinking on any subject is never just simple. It has a built-in complexity as well. Our understanding of war, peace, conflict, poverty and everything else and our ability to achieve desired change is a function of the laws of fractals, chaos and complexity.

In seeking a novel approach to world peace, Deepak Chopra mentions the power of thought, that a suppressed will can influence the future and that, “reality is built from the most subtle level, a fleeting intuition or wish, a desire that won’t go away,” adding that “thinking about peace is a powerful means to make it happen...” This happens through the features of fractals and chaos acting on these thoughts. Their components make things happen. Chopra says that breakthroughs are not random events but happen because the earlier building blocks have done their job.

Thus in any negotiation, conference or discussion, recognition of these components of thought, the earlier building blocks contained, behaving like fractals do, will shape the future. Perceptions and responses are a function of these dynamics and make the future.

Recognizing the fractal nature of thinking is thus important in any interaction of thinking, from peace talks to day to day discourse. Thinking is not just simple; it exhibits complex dynamics and has component parts reflecting its past, which must be considered.

***The heart mantra that opened this book is an example of a fractal thought, illustrating these ideas and also its power to create change.***

## Heart Mantra: from <http://www.intrex.net/chzg/heart.htm>

*“Smash it into a thousand pieces. In all the thousand pieces of your life, each piece becomes a mirror. In all the splinters and bits and pieces of our daily life, each one is still a mirror, reflecting in its own sphere, having that clear mirror quality” from web page above.*

As Dogen (1200-1253), founder of the Soto lineage of Buddhism says, "Even in each dewdrop on the grass, the whole universe is reflected."

*“Our mantra must be extended like a thread that runs through all of those bits and pieces, even if we don’t see it. It is not a thread that ties it into a big bundle. It’s a thread that makes all of the pieces consistent with each other. This is how we express the mantra and how prajna is brought forth in our daily life. This is an interesting way to think about it. Mantra is our daily activity expressed moment after moment. It’s not just something written down at the end of a page” from web page above.*

**The heart mantra is fractal:** The thousand pieces reflecting life is like a fractal, each being part and whole at the same time, self similar, with common threads but a bit different. It is like the tapestry of life, described by Susan Blakemore-Brown in her book “Reweaving the Autistic” tapestry, threads woven together dynamically into everchanging patterns with an underlying theme. Every part magnified looks a bit like the whole, each fractured mirror and each dew drop.

This mantra is universal and very powerful, a fractal thought to shape the future, hence its use at our Toronto Tsunami Heart Valentine event, illustrating chaos and relevant to the tsunami.

## Fractal metaphors.

*Page by Vanessa Rambihar with “Alice” ideas from high school Essay.*

Michael Barranger at the MIT Center for Theoretical Physics says that we live among fractals and that we feel much more comfortable among them than among the figures from our elementary school textbooks. There are fractals everywhere, from waves to mountains, from particle physics to galactic collisions. Just look at clouds with their everchanging patterns and try to describe them by triangles, squares and cones, then by undulating wavy patterns within patterns. We even use fractals in our day to day life, in our speech, poetry, art and science, to evoke feeling and convey emotion better. We are comfortable with these fractals we use and live with, often not knowing they are fractals. Look around and you will find them.

The mirror of the heart mantra not only reflects the universe, but *is* the universe. The looking glass that Alice wandered through in her adventures in Wonderland is similar, full of fractals, exposing her to order and chaos intertwined, not surprising since the stories were written by Charles Dodgson, a well versed Oxford mathematician, whose interests ran deeper, into logic, photography, art, theater, religion, medicine, and science. I think he sensed fractals and chaos, but lacked the vocabulary and imagery to grasp it, which only came later, after its description in the later half of the 20<sup>th</sup> century and the advent of modern computers. I think Alice could be rewritten from a fractals and chaos perspective and convey exactly the same feeling.

The Wonderland Alice experiences is the world of chaos and fractals, with worlds within worlds unfolding when she disappears in the rabbit hole, differing scales as she grows smaller and then larger, uncertainties and bifurcations and much more. William Blake’s “to see the world in a grain of sand” directly conjures up fractal images of space and time. Much of art, literature and music is similar, the beauty residing in the creative tension between order and chaos, within the nuances and the sensitivities exploited or exposed by the creator, to make connections to invite the viewer to enter the worlds within worlds of uncertainty, surprise and wonder. Religion, spirituality and any deep thinking do the same, like the mantra.

***Fractal metaphors inspire us to not only reflect on the world, but to be the world in a deep spiritual sense.***

## Fractals and chaos as art and science

David Bohm is a quantum physicist who feels that *science should become more like art*. His dialogue with Eastern philosophers and spiritual leaders such as the Dalai Lama and Krishnamurti reinforces his feelings. Briggs and Peat in *Turbulent Mirror* quote Bohm as saying that instead of science discarding alternative scientific theories in favor of one “accepted” theory, scientists should pursue the possibility that scientific truth, like artistic truth, is a matter of endless nuance of “worlds in rotation.”

Bohm says that there are many, even opposite ways to see nature, and Briggs and Peat note that artists have known this for a long time. Musical pieces, art and literature are replete with ideas of fractals, chaos and complexity, long before we had words for these (search internet for explanations and examples). Examples are the fractal nature of the musical metaphors in great compositions with self similarities at different scales, described by Leonard Bernstein lecturing at Harvard and fractal music such as that created by Harvard cardiologist Ary Goldberger and his son Zach Davids (see web for examples).

Nuances and subtleties reside at the edge of chaos. They illustrate the importance of extreme sensitivities, with the potential for amplification of even slight differences. Metaphors elicit such subtleties and nuances since metaphors imply similarities between seemingly different things. An interlocking series of metaphors is a *reflectaphor*, as seen in some art and writing, with irony, simile, puns, paradox, etc. that create an unresolvable tension or wondering, doubt and uncertainty or nuance according to Briggs and Peat. The reflectaphor is a fractal, and the nuance self organizes at the edge of chaos.

***The mantra as a mirror to the universe is fractal and a reflectaphor. But what are reflectaphors for?***

## Reflectaphors - art and science?

Reflectaphors are a series of interlocking metaphors that feedback unto themselves. Artists use them to create a tension that leads to ambiguities and uncertainties. Truly great art reveals new meaning and feeling even after repeated viewing or reading. The tension is created by the juxtaposition of self-similar forms with differences, enough to jar the mind and stir the imagination. Briggs writes in *Fractals: the patterns of chaos* that this reflectaphoric tension is so dynamic that it jars the brain into wonder, awe, perplexity, and a sense of unexpected truth or beauty.

The title and themes of this book are also reflectaphors, with many similarities and differences cycling back to each other, some revealed only by peeling back layers of understanding. The fractal and chaos nature of reflectaphors thus make this book on heart both art and science, the gap bridged by chaos and complexity. The subtitle of Briggs' book reveals the power of chaos for this unification or consilience (EO Wilson's term for the same thing) – *a new aesthetic of art, science and nature.*

Briggs says further that the deepest gift that fractals and chaos may bring is the opportunity these ideas offer for radically changing the way we look at nature, and I would add, everything else. He asks if we shall inhabit a world shaped by mechanically interacting fragments driven by mechanical laws and awaiting our assembly or control, or one of fractals and chaos – that is alive, creative, and diversified because its parts are unified, inseparable, and born of an unpredictability ultimately beyond our control?

***We can now see the world as reflectaphors, no longer either art or science, but art and science unified by fractals and chaos.***

## Art, heart and science of everything.

Medicine is the art and science of caring for humanity. Heart is sharing and caring, for humanity and for the planet. Art and science have taken us in different directions in the past. Fractals, chaos and complexity offer an opportunity to unify art and science. It allows us to learn about nature, life and the universe while being creative at the same time, using deep insights to reflect, to rethink the world and to create lasting change. We can move from the heart to the edge of chaos, the creative edge of the world, where things get done and where artists and scientists now reside.

Fractals, chaos and complexity awakens us to new ways to see the world, removing the reductionist microscope and revealing the full beauty of nature in everything. It shows order in chaos, the interplay between the simple and the complex, and allows us to see and grasp infinity. It gives us the lever for change, to use sensitive dependence and knowledge of how things really work, to create change.

We have the science, we have the art, we have them combined, but do we have the will to make a difference. It seems we do. The global heart emerging from the chaos of the tsunami is a spontaneous emergence and self-organization of support. This is a new global heart arising from the tsunami.

The new global heart emerging is at the same time the heart and the edge of everything. We are poised at the edge of chaos, with an opportunity to use these new ideas to ***rethink the world and to make it a better place.***

*“The \$25 billion that one would need to launch a serious attack on the killer diseases in the poorest of countries is about one-thousandth of our [US] annual income or around ten cents for every hundred dollars of our income.*

*In other words, utterly affordable.”*

Jeffrey Sachs

Tsunami to tsunami heart  
rethinking the world

## Tsunami

While we were enjoying dinner on Christmas night, December 25<sup>th</sup>, 2004, around 8 pm for those of us in Toronto, two tectonic plates, moving slowly 6 cm each year, abruptly shifted 15 meters along a 1200 km stretch at the bottom of the Indian Ocean. This was an act of chaos, a sudden bifurcation like the last straw.

It displaced possibly billions of cubic meters of sea water that surged in two directions across the Indian Ocean at the speed of a jet plane, eventually crashing its shores as huge waves taller than buildings, wreaking havoc and chaos everywhere in its path. Over 160,000 lives were lost in this, the most extensive natural disaster in human history, inciting an unprecedented outpouring of support across the globe.

It was born of chaos and caused chaos (a Greek word for a gap out of which everything - order and chaos, arose). The fault line was the source of the chaos, the gap out of which everything arose. The ensuing chaos was an unimaginable different kind of chaos.

It was real scientific chaos that caused the earthquake and then the tsunami. According to chaos theory, things self organize to a point of self-criticality before suddenly and unpredictably exploding, as described by the chaos physicist Per Bak. This he claims is the nature of things for many complex natural, social and man-made situations. The unpredictability is called “strange,” meaning that we know the earth will shift some time, but we cannot tell exactly when.

Chaos scientists graph time pattern of earthquakes and similar events, but accurate prediction is limited by the complexities and inherent chaos of the systems involved. There are too many variables to consider and in such complex systems, a slight difference in initial conditions makes the details of the outcome unpredictable.

Yet at a macro level, there seem to be some pattern evident in time series of natural disasters when graphed mathematically. Such knowledge is being used to design better predictive models as well as earthquake resistant houses, office and roads, etc to reduce the toll from disasters.

From chaos theory:

Sensitive dependence on initial conditions: a slight change in initial conditions spiral through complex systems and may change outcomes dramatically. Discovered by Edward Lorenz, an MIT meteorologist who found exactly this after returning from coffee in 1961 after rounding out input data in his computer at three decimal places.

Per Bak, a Danish physicist did computer simulations of sand piles, showing that when adding sand slowly to a pile, it builds up gradually to a critical point when one more sand grain causes the stable pile to crumble to a new shape. There has been some criticism about the generalisability of this research, but the imagery lingers. Per Bak suggests that complex systems self organize to this point of self-criticality before sudden collapse from a tiny input. He suggests that this is a principle that could explain physical and social phenomena, *from societies to clusters of galaxies*.

## Starquake day after tsunami earthquake

Speaking of galaxies, at around the same time the tectonic plates slipped causing the earthquake, a rare, unrelated but similar galactic event was recorded, the physics of which is similar.

What is described as the greatest cosmic explosion ever monitored – a starburst from the other side of the galaxy, was recorded while we were having dinner the day after the earthquake, a “monster” magnetic flare from a neutron star 50,000 light years from the earth, ie three billion times as far from us as the sun. A neutron star is a very dense collapsing star with a huge magnetic field. Such events are rare, occurring once a lifetime or once a millennium.

Why that happened is unknown. According to the Feb 18<sup>th</sup> Yahoo website, “One theory is that the energy release comes from magnetic fields which wrestle and overlap because of the star’s spin and then snap back and reconnect, creating a ‘starquake’ rather like the competing faults that cause an earthquake.”

There is an interesting story about such events. Writing about the metaphor of *voyage* for South Asians migrating and acquiring Western risks of increased heart disease, I mentioned Subramanyan Chandrasekhar, who figured out neutron stars and their collapse, while on ship from India to Italy en route to Cambridge University, at the age of 18. Although his idea was dismissed by his mentor, Sir Arthur Eddington, he was awarded the Nobel Prize in physics for it in 1983, some 50 years later.

Self-criticality and chaos are at work throughout the cosmos, from the far reaches of the visible universe to our quarks and atoms, from starquakes to earthquakes, and the human scale events that touch us directly, such as the tsunami.

## More tsunami chaos

The ensuing tsunami chaos, brought vividly to our living rooms like never before, was unimaginable. It all was the simple pure usual chaos expected when giant waves engulf everything in their path, swirling and crashing like violent stormy seas on land, destroying everything. This everything includes physical structures, people, families, the society and the support structures and organization that emerge around them.

The chaos to come will be more death and destruction from diseases as well as the loss and destruction of the physical and non-physical things affected. These latter things took a long time to self-organize, nurture and to create, and will take longer to restore.

The patterns of the usual and the unusual we hear about on the news, and the somewhat expected and unexpected, are also all the manifestation of new and scientific chaos. The turbulent waters followed the laws of chaos throughout, ripping apart families, submerging one child and not the other. Chaos produced these strange patterns of order within disorder, even as the waves advanced in their path of destruction, but with much more disorder than order because of the massive energy and turbulence involved. And it was dynamic, changing every minute, or even second.

Knowing this does not help us to change the past, but it helps us to understand the reality of the irregularities observed, and perhaps could help us to design for the future, to reduce the toll, using the knowledge of how these things happened. We could also design resilience into people and to societies at risk, to better cope with such eventualities.

The inevitable question now is, what could have been done differently? Perhaps using the new science of chaos and complexity may improve prevention, and increase resilience of both structures and communities, all so easily destroyed by chaos.

## Tsunami Heart: a tsunami of support

Jeffrey Sachs, Director of the Earth Institute at Columbia University, and author of the forthcoming *The End of Poverty*, writes about the tsunami, the global response and concerns about the future in an essay in the Time magazine of January 10, 2005.

He says that “a world divided by ethnic and religious disputes suddenly faced its common humanity – and common mortality – in a disaster of shocking geographic reach.” He noted that the world is for now, “united to aid millions of vulnerable people trying to piece their lives back together in the wake of the devastation.”

There has been a tsunami of support. Less than two weeks after the disaster, Médecins sans Frontières and other charities say that they have received as much money they need to deal with their immediate tsunami relief efforts, and that further donations will be directed to their other endeavors. More than enough clothing was collected and more than enough doctors volunteered.

This largest humanitarian effort ever was launched and the largest amount of money raised for a single crisis achieved in a very short period of time.

This level of support should be sustained, however, to deal with continuing problems after the tsunami, and also with problems in other parts of the world and to address other long term needs.

The tsunami should keep global poverty reduction on the agenda, as a pressing and achievable goal.

***Jeffrey Sachs says it can be done.***

## Beyond tsunami and disaster relief

Jeffrey Sachs claims in the Time magazine essay that disasters hit the poor the hardest, and that it doesn't have to be that way.

Although claiming the lives of many tourists from rich countries, this tsunami devastated developing countries and likely eliminated over 160,000 of their people, mostly poor.

In the essay, Sachs illustrates how the poor suffer disproportionately to the forces of nature, which he claims provides the key answer on how to proceed after the tsunami.

He says that “if rich countries continue with business as usual, responding generously to the current disaster, but failing to address the dire underlying situation of the world’s poor, the world will repeatedly confront the tragic arithmetic of life and death.”

He continues “this is not merely a sound forecast based on the likelihood of future earthquakes, droughts, floods, landslides, and epidemic diseases,. It also reflects the grim facts that life and death disasters of the poor are with us every day.”

Natural disasters cause mostly hardships in rich nations, but mass deaths in poorer countries. The rich have designed their world to protect themselves from natural disasters: live away from much of the risk, have early warning systems, seismic monitors, weather forecasts, and disease surveillance systems. The rich can quickly mobilize relief after disasters.

The poor can't.

***It doesn't have to be.***

## Tsunami Heart: changing the world.

3 Million impoverished children die of malaria every year.

Prevention exists.

Nearly 1 million children die each year of measles.

Preventable with vaccine available.

Tens of millions of Bangladeshi citizens daily drink water contaminated with natural arsenic poison. Fixable.

11% of the world's population (sub-Saharan Africa) has 64% of the cases and 74% of AIDS deaths. Reducable.

Jeffrey Sachs claims that “The failure of the US and other countries to respond to respond to such utterly solvable crises results not only in massive and unnecessary death but also in a vicious cycle of poverty and political instability that often pulls the US directly into the fray.”

He says that although the US pledged at the Monterrey Consensus a few years ago to make concrete efforts to provide 0.7% of national income to the world's poor, it still now gives 0.15%.

The poor are extremely vulnerable to natural disasters and to continuing daily disasters from poverty.

If rich countries can be persuaded to understand the continuing need beyond disaster relief, to sustain interest and heart, millions of people would be removed from poverty, millions of lives saved and many spared the extreme consequences of natural disasters.

***It can be done.***

## Tsunami heart: rethinking the world

The tsunami allows an opportunity to rethink the world. The tsunami is one disaster, though unprecedented. There have been others and there will be more. While we struggle to come to grips with this disaster, the suffering, loss of lives, and untold consequences, it is worthwhile to remember the suffering elsewhere.

British Prime Minister Tony Blair says “There is the equivalent of a man-made, preventable tsunami every week in Africa.”

Supporting the need for rethinking is his further statement that “The tragedy of the tsunami was through the force of nature. The tragedy of Africa is through the failure of man.”

Jan Egeland, UN humanitarian chief said “I am getting increasingly satisfied with how the world is responding to the tsunami victims and I am getting increasingly nervous for all of the forgotten and neglected emergencies.”

Aid groups claim that nearly 4 million people have been killed since the start of a five-year war in 1998, in Darfur and the Democratic Republic of Congo, mostly from war induced disease and starvation, (J Fowler, AP, Globe and Mail, Jan 8, 2004). Also reported is that 1,000 people die every day from war in the democratic republic of Congo. About 70,000 people have died from disease, hunger and attacks from conflict in Sudan in the past nine months.

And this is only one region of the world and one problem. Within a month of the tsunami there have been new, though much smaller natural disasters, such as mudslides in California and British

Columbia and floods in Guyana. When I grew up in a small village on the coastline of Guyana we would experience periodic and mostly brief flooding, since much of the inhabited strip of coastline is below seawater, making the integrity of seawalls and drainage systems of sluices and kokers crucial. Silting of these drains allowed excessive rainfall to overwhelm the system, with the resultant risk of diseases and people driven from their homes.

Such is the need for funding for continued maintenance of systems and prevention of problems in addition to the need for greater assistance when such systems fail. Long term needs across the world thus need to be addressed in addition to acute need.

Immediate, predictable and long-term aid, and full debt relief for some debt-burdened countries are being achieved. Doubling aid from wealthy countries is being sought. The Economist, June 18-24, 2005 however warns, "The G8 wants to wipe clean the debts of impoverished nations. Erasing poverty will be harder." There is a simple and a complex here. Nobel Laureate Amartya Sen says that although important, money is not the solution to poverty. There are social, political, health and other concerns, impacting on and beyond poverty that need to be addressed. Tremendous extreme systemic disparities exist worldwide, with multiple causes.

***Serious rethinking is required.***

Lt-General Roméo Dallaire on returning to Rwanda ten years after witnessing one of the largest acts of genocide said,  
"While I'm watching TV coverage of the tsunami devastation in Southeast Asia, I'm also mindful that another genocide is going on in Darfur in the Sudan, and once again the world is watching from the sidelines."

## Tsunami and massive change

The tsunami has created massive change of two kinds and there is much more to come. First, the devastation and loss of lives and second, it raised global awareness of need, not just for disaster relief, but for sustaining support.

Tsunami heart will ride a wave of optimism about poverty reduction in 2005. The December 18, 2004 Economist, just prior to the tsunami, has an editorial titled “Making poverty history.” It says “In 2005, poverty reduction is scheduled to dominate the global policymaking agendas as never before” listing these events:

Jeffrey Sachs’s study for the United Nations

Tony Blair’s Commission for Africa

G8 Summit focused on poverty reduction

UN Special General Assembly Summit to review progress towards the Millennium Development Goals to halve the world’s poor population by 2015

World trade Organization to liberalize global trade with benefit to poorer countries

Making poverty history will be massive change as illustrated above. Bruce Mau and Jennifer Leonard’s book *Massive Change* reinforces the concept of designing the world, “Massive change is not about the world of design, it’s about the design of the world.”

They claim that “new systems of design – of communication, production, evolution and exchange- have the potential to create shared wealth on an order of magnitude the world has never seen. Design and its capacities promise to make this century a new era of wealth worldwide.”

***We now have to move from potential and promise to set realistic goals and achieve them.***

## Tsunami response: why is this one different

There have been disasters before with greater loss of lives and less response. But that was before the internet and the increasing globalization of information technology bringing vivid images to everyone's home. When Krakatoa erupted in 1883 causing a tsunami, the world heard via newly laid telegraph cables. This tsunami was seen at close range. Now we see bodies floating away and children wrested away by waves rather than just reading or hearing about it. More lives were lost in an earthquake in China in 1976, but there was no 24 hour streaming of images to grip our attention then.

This tsunami also affected many countries rather than one. Also people from these countries have migrated all over the world but many still feel part of the countries they left, going beyond just interest or having relatives there. The migration has also spurred an increasing awareness of the need to embrace diversity and sharing with all people globally.

We have been primed to disaster and adversity by 911, wars, scourges, famine, etc. but they are a bit distant for most of us. This is not only brought close, but is home for many.

Allan Gregg, Chair of the Strategic Council asks in the Globe and Mail Jan 7, 2005,

“Will our generosity last, or, as has happened in the past, will our charity recede along with the images of disaster?”  
He feels that the phenomenal response to the tsunami should teach us to make it last.

## While we wait

### *Each day in Africa*

Over 6,000 people die of AIDS

Over 3,000 people die of malaria

Over 1,000 people die of TB

Over 2,000 people die from unsafe drinking water.

Over 2,000 die from childbirth related diseases.

130,000 people die of preventable diseases each week in Africa.

### *The tsunami killed about 250,000 people.*

This is roughly the number of people killed

EVERY 2 WEEKS

in Africa alone from preventable causes.

Parker Mitchell and George Roter report in the Globe and Mail, Jan 11, 2004, that “There will always be natural disasters, but their impact is compounded by poverty and poverty is a problem that persists.”

They claim that while the tsunamis highlighted that issue in Asia,  
*Africa suffers a silent tsunami every week.*

Lest we forget. Darfur is on the agenda again with atrocities, death and destruction.

Natural disasters continue and require attention. Since the tsunami, there have been mudslides in California and British Columbia and severe flooding in Guyana and Mumbai, hurricane Katrina, and the South Asian earthquake, thought to be an even greater disaster.

We are to some degree torn between what to support. There is concern among aid agencies that the outpouring of donations to the tsunami would be followed by reduced support for other pre-existing and later situations of need around the world.

The Economist Jan 8, 2005 reports,

“Disaster aid is often thought of as different...aid given after a natural disaster is pure, an affirmation of the best of the human spirit, uncontaminated by politics. That’s what’s used to be said.”

“...as construction begins, the disaster relief will start turning into development aid...[Expect] disappointment”

“It is as important and as inexpensive to save lives in Congo as it is in Aceh and in Sri Lanka.” Jan Egeland, UN emergency relief coordinator. He also said that the needs after the SA earthquake in November 2005 may be greater than after the tsunami. Especially since there is winter to contend with, and landslides blocking access to the people in need, etc.

It’s hard to keep all of this in focus and in perspective.  
But we should.

Eight million people die each year  
because they are too poor to stay alive

In the time it takes you to read this box,  
seven children will die as a result of  
extreme poverty  
[www.makepovertyhistory.ca](http://www.makepovertyhistory.ca)

## Tsunami timing: seize the moment

Everything seems to be coming together now for a serious and concerted effort in reducing global disparities. We are at a Tipping Point, an idea from Malcolm Gladwell's book of the same name, where things build to a point of rapid change. His 2004 book *Blink* may explain to some degree the unprecedented tsunami heart displayed globally. It describes those "gut feeling" and instantaneous decisions that are life changing, and that are often, although not always right.

We are at an important intersection in the world. There is a unique opportunity to make the massive change happen now.

The world has heard, seen and felt the need, and things are happening. Loans and debt of poorer countries that have hamstrung their development are being forgiven.

The time is right. It is possible, and it's easy to do. There is now a global consciousness of humanity as never before. The world and its problems are now brought close to all of us and so are the solutions.

Jeffrey Sachs says that

***"The \$25 billion that one would need to launch a serious attack on the killer diseases in the poorest of countries is about one-thousandth of our [US] annual income or around ten cents for every hundred dollars of our income. In other words, utterly affordable."***

***Can you spare a dime to fix the world?***

We did for the tsunami. Can we sustain it after the blink?

## Sounds simple: but also complex

It does sound easy and simple, but reality is more complex, with many challenges. The tremendous diversity we cherish also brings with it competition and strife. Religious and ethnic factions clash, and ideas diverge. Aid was delayed for many hours after a cargo plane hit a buffalo on the runway. Political difficulties in Sri Lanka and Indonesia complicate distribution of necessary aid in some areas. The DART relief system from Canada was delayed over similar concerns. The Thailand government says it has the means to handle the crisis and declines aid as does some of the indigenous and mostly self-sufficient people in Andaman islands.

How to handle these complexities within the framework of needs and our desire to help may require novel approaches.

The tsunami should teach us of our tremendous interdependence, that nature is fickle and that every one of us and every nation is vulnerable. It should teach us of our common humanity and, as Jeffrey Sachs reminds us “we have to do this together.”

The tsunami has taken us to the right place. We now need to keep ourselves there. Janice Gross Stein says that we need to think outside the box when confronting the unimaginable. Much of the ideas expressed so far would have been inconceivable a decade ago and qualify for out of the box. We have seen the unimaginable. Let us now re-think, with inside and outside the box thinking...and then seek action.

Perhaps we need an “Out of the Box Institute” to complement the usual thinking, *to rethink how we decide what to support*, to sustain action and to deal with the complexities of the real world.

## Global heart emerging after the tsunami did work.

### The Second Tsunami That Wasn't

July 24, 2005 New York Times editorial

This editorial, six months after the tsunami, reminds us that the outpouring of global support after the December 2004 tsunami worked. It says “people worldwide who gave generously to help the victims of the tsunami can be satisfied that their money saved lives, and will go on saving them.”

Despite the complexities involved, and many remaining challenges, global heart emerging worked. The editorial says that, “This was not a case of aid officials exaggerating the peril in a bid to increase donations. Instead it was a story of aid done right.” Novel ideas and lessons learnt were put into practice. The spike in diseases expected never materialized. Measures taken during the tsunami recovery continue and now improve the lives of people in the areas affected, even after the tsunami.

***Re-thinking tsunami recovery worked.  
Re-thinking to make a better world  
should also work.***

*“We can not solve problems by using the same kind of thinking we used when we created them.”*

*Albert Einstein*

*“There is simply no way to manage the diversity and complexity of 21<sup>st</sup>-century society with 17<sup>th</sup> century concepts...”*

*Dee Hock 1999*

RE-THINK and change THE WORLD

## Thinking outside the Box

Janice Gross Stein, Director of the Munk Center for International Studies at the University of Toronto, wrote in the Globe and Mail newspaper on Jan 6, 2005, that we must think outside the box when responding to the unimaginable, such as the recent tsunami.

Countless lives were lost and the future of families destroyed because of a lack of warning of the impending tsunami. A warning system, however, though desirable can cause costly false alarms, and is not that straightforward in a region of competition, ethnic strife and other challenges.

A big problem was that the information of an impending catastrophe was available, but not shared because of logistic difficulties, lack of phone numbers, offices closed for the holidays, etc.

Stein contends, and her students at U of T agree, that *imaginative and creative ways should be found* to deal with such situations, especially potentially disastrous ones like the tsunami.

In “What stirs hard hearts” Globe and Mail, March 28, 2005, Stephanie Nolen wonders why there was such outpouring of support for an individual in need, while the AIDS budget for the Global Fund to fight AIDS, TB and Malaria is chronically short. She also notes the outpouring of support for tsunami, yet diminished support for other chronic disasters.

In the same article, James Orbinski noted the increasing difficulty in obtaining funds for AIDS treatment.

Seems like we need some out of the box thinking to find solutions for both acute tsunami-like and chronic disasters.

## Rethink channels and protocols

Thinking outside the box, Janis Gross Stein claims, could have led to novel ways to warn people to flee to the hills and countless lives may have been saved.

Stein says that after the magnitude of the earthquake was revised to 9.0, the level above which tsunamis arise, and it had crashed on the shores on Thailand and Indonesia, there were two hours available to warn Sri Lanka and India. Stein said that phone calls were made around the Indian Ocean but “colleagues were hard to reach” and that information was given to the US State Department.

She says “Here is where officials need to think outside the box.

Even during the holiday season, with people away from their desks, the officials could have scrambled to notify senior staff at the Pentagon who, in turn could have warned their counterparts around the Indian Ocean. Officials could also have gone to the highest levels of the US government, through the office of the national security advisor. Here too, within minutes, that office could have alerted the affected countries.” This would not have saved everyone, but would have saved many.

***Innovation and creativity are required for such situations.*** She says that, “we can’t prepare for the unimaginable if we worry about channels and procedures.”

An example of rethinking the channels and procedures is the food-aid rules in Canada where 90% of Canadian food-aid must be from Canadian farms. This is limiting, since Asian farms can deliver more food, less expensively and faster. Rethinking this is being currently achieved.

## Complex networks and spreading information.

Barabasi and Watts tell us about eight degrees of separation and of network theory, with strong and weak links. Surely spreading the word, asking everyone to spread it further would have reached across vast expanses fast. The world wide web is the best example of instant world wide communication, eliminating time and space in getting such information out. One of Stein's students suggested asking CNN, the perpetual news station open 24 hours all across the world, to broadcast warnings, which will be picked up and recirculated even when offices are closed. Another suggested text-messaging, which though useful, has a problem of false information.

The solutions offered don't matter. The students needed to get something done and focused on somehow getting it done .

Stein says that her students "thought outside the box, paid even less attention to procedure, and quickly designed a network to activate multiple points, build redundancy into the system and use publicly available media to push through all the usual obstacles."

In planning for the future we should heed her advice, that officials don't tend to think that way, and they did not in the crucial moments after the tsunami struck.

***Stein said "we cannot prepare for the unimaginable unless we learn to think laterally outside existing hierarchies."***

*These ideas were validated in the earthquake of March 28, 2005 (fortunately, with no tsunami after), where text messaging, radio broadcast and similar methods were used and there was immediate warning and official commitment to disaster relief.*

## Further rethinking: Complexity and chaos.

We live in a world of competition and cooperation. For individual and community success, we need to dynamically balance these opposing tendencies.

The systems in which we find ourselves enmeshed are complex and adaptive, like an ecosystem or web, with multiple levels of feedback and change. There are many interacting parts that influence each other and change outcomes. These follow the rules of chaos and complexity

To understand such systems and to create desired change within them, we need to learn about chaos and complexity, with its new rules and new meanings, models and metaphors.

Heinz Pagels, physicist and former President of the New York Academy of Sciences said in 1988 that,

*“I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century.”*

We need to learn about **complexity**, the science of complex things, to deal with the things we call **complex**, at all times, not just at times of chaos.

## Chaos and complexity as *thinking outside the box*

Such thinking works. A team at the Scarborough Hospital reported over a decade of experience using novel ideas from chaos and complexity science in a community heart health project (1990-2005), going outside existing hierarchies, facilitating the emergence of networks, allowing emergence and self organization in promoting heart health.

Chaos and complexity is the new science explaining how and why things happen. It is the science of networks, of nature where everything is connected web-like at multiple levels and to varying degrees. Action at any part of this web of connections may cause effects at a distance. The mathematics of such networks suggests new rules that govern how things change. Understanding these complex dynamics is important in achieving change. An example is shown below.

Part of the conclusion of book chapter: *Using complexity science in community health promotion: novel perspectives and a tool for change* in Complexity in Healthcare Organization. VS Rambihar. Ed D Kernick. Radcliffe Press, Oxford, UK. 2004.

*Four projects within a complexity-based health program have been described. Common features of these projects were distributive structure, emphasis on interactions and interrelationships, creation of networks, the use of improvisation, open-ended discussion, agenda-less meetings, diversity of opinions, autonomy, self-organization, and emergence from few and simple rules. Interdisciplinary dialogue developed and networks with strong and weak ties and random contacts were established. Complexity science was also used as a powerful tool for change and a lever to amplify small inputs. Uncertainty, unknowability and the unexpected were accepted and anticipated, leading to learning methods to deal with inevitable surprise. A chaos and complexity perspective was used to explain causation of heart disease and the strange predictability, surprise and uncertainty observed. Evidence was adjusted according to context to guide prevention in a chaos-based or evidence-based in context approach.*

Jon Kabat-Zinn in his 2005 book *Coming to Our Senses: Healing ourselves and the world through mindfulness* explores novel ideas for reality:

“...the emergence of the complex, like life and sentient, from the less complex, like inert matter, in dynamical systems is one way of looking at the interplay of chaos, complexity and order in attempting to explain them to ourselves conceptually, rationally.”

...and the other, more Buddhist view that  
“consciousness cannot come out of matter.”

He writes about the fascination of “these two ways of exploring the nature of reality and the nature of mind in dynamic dialogue,” which are now being widely explored, in particular at the meeting of the minds at Massachusetts Institute of Technology where the Dalai Lama engages in dialogue with neuroscientists, physicists, psychologists and anyone else interested.

Kabat-Zinn extends this with real  
***out of the box re-thinking,***  
***beyond just understanding,***  
to use chaos and complexity ideas to change the world.

*As the science of complex interactions, chaos and complexity provides a new perspective for understanding the complexities of health and healthcare, as well as for creating change and transformation for personal, community and global health.*

*Heart attacks are born of chaos and cause chaos.*

## ***NEW for 2006***

*Current risk assessment is not enough. We need to search early for heart disease. New tests are now available.*

*People considered low risk by Framingham or usual methods, may already have heart disease.*

*Of 100 “**low risk**” women – 32 had “significant” subclinical atherosclerosis. (National Review of Medicine, Jan 2006, from American Heart J Dec 2005).*

*Family history is a good predictor.  
45% increase risk if sibling has early heart disease.*

***Our challenge is to put in place the things that ensure heart healthy living and reduced risk for each of us, for our community and especially for the vulnerable.***

## Rethink Heart Health

### *How does complexity help?*

*There is real mathematical, scientific and deterministic chaos in the heart and the rest of the body, from the networks of genes and metabolic systems in the cells to heart rhythms, brain waves, and likely everything else.*

*This is an entirely different and scientifically rigorous field of study for chaos and heart, which is **not the focus of this book**. Example: order and pattern within the random appearing ventricular fibrillation that leads to sudden death, now being harnessed to improve health.*

*You can search the web for more on this or PubMed for journal articles or books, a few listed below and Google Leon Glass and Ary Goldberger, pioneers in this field.*

***Chaos in Medicine.** RT Sataloff, M Hawkshaw Singular 2001  
Source Readings, with extensive references and reprints.*

***Complexity for Clinicians.** Tim Holt. Radcliffe Oxford. 2004*

***Chaos 2000: Making a New Medicine for a New Millennium.** VS Rambihar. Vashna Toronto 2000.*

***Fractals and Chaos: Simplified for the Life Sciences:** Larry Liebovich. Oxford University Press 1998.*

***Fractal Physiology and Chaos in Medicine.** Bruce West. Teaneck. 1990*

# Heart Health across the world

*Is heart health a concern globally?*

*Can improving heart health make a better world?*

*How do we improve heart health worldwide?*

*Can a complexity perspective help?*

Novel ideas from the Dec 2005 Update to this book (see end pages), are inserted here as **feedback and iteration**, to facilitate even more transformation and change.

Make your best health to make a better world.

Improving heart health can lead to poverty reduction, peace, health and development.

If we observe health and healthcare, we find complex dynamic interactions of countless influences, systems and subsystems, including genes, the mind and the internal and external environment, with multilevel feedback, adaptation and change. Such complexity appears at the biological, social and environmental level.

Much of the region afflicted by the tsunami, one of the poorest in the world, has high rates of heart disease. Prevention is now crucial, especially in middle and low income countries, already vulnerable to many other problems. ***We could thus take the tsunami as an opportunity to rethink heart health, especially for the more vulnerable, everywhere.***

## Heart health facts

*Heart disease and stroke kill 17 million people per year and by 2020 will become the leading cause of death and disability worldwide.*

*Vulnerable people suffer more from heart and chronic disease as they do from the ravages of tsunamis.*

**Women are equally affected.** *As of last year, the number of women with heart disease has equaled that of men.*

*Risk factors for an individual and for a community reasonably predict risk and can guide prevention and treatment.*

*There are **fractal patterns of distribution**, which offer opportunities for prevention and treatment.*

*It's mostly in the interactions: diet, lifestyle, genes, the mind and behaviour, etc: Everything touches the heart.*

*Prevention requires individual **and** population strategies addressing the personal, medical, social, economic and other determinants.*

*Increasing obesity and adverse diet and lifestyle choices in all countries will increase diabetes, high blood pressure and heart and blood vessel diseases dramatically, with serious personal, social and economic consequences to individuals, families and communities.*

*Complexity, the science of interactions may be useful for individual and community strategies and actions, globally.*

## Valentine's Day Tsunami Heart

We explored this at our Annual Valentine's Day for Heart Health Event at The Scarborough Hospital in Toronto. Now in its 22<sup>nd</sup> year, it started with the simple notion that *since Valentine's Day is about heart, we could use it for the promotion of heart health*. We used complexity type ideas since the beginning, but only recognized this around 1990. For 2005, a Tsunami Heart Global Heart theme was added. This will now include global heart health, to recognize the outpouring of support after the tsunami as a global heart emerging, which we should aim to sustain.

### ***Did you ever wonder how Valentine's became associated with heart? Or how Valentine's heart and sending cards began?***

Gail Godwin writing in her book, *Heart* says that the first recorded Valentine reference as romance was in a February 1477 letter from an anxious English woman to her fiancé, "Upon my right welebelovyd Voluntyn ..., be this bill delivered."

### ***Or why Feb 14<sup>th</sup>?***

Valentine's Day likely was the 15<sup>th</sup> of February, from the ancient Roman feast of Lupercalia (Lupercus - the god of fertility). It became a festival, popular to Christian times, although considered lewd and heathen. February 14 is also supposed to be the day in which birds were supposed to begin mating, explaining the birds we see on Valentine's cards.

### ***Or how did Valentine's Day get its name?***

...from a former Saint Valentine (removed from Sainthood by the Roman Catholic Church in 1969), who was martyred on February 14, 270 AD, or from a Bishop Valentine, who may have been the same person. This gave the church the opportunity in the fifth century to ban the Valentine festival and substitute Valentine's Day instead.

***Valentine's for us now goes beyond heart, heart health and health promotion, to sustaining global heart.***

## Risks for heart

Eight *treatable* risk factors for heart attacks that apply across countries, cultures and ethnicities account for most of the risk of heart attacks in men and women, at all ages and in all regions (Interheart Study, Dr S Yusuf and colleagues) - smoking, abnormal cholesterol, diabetes, high blood pressure, stress, abdominal obesity, sedentary lifestyle, and increase fruit and vegetable intake. Alcohol in small amounts was also of benefit, but is not recommended, since it can cause more harm than good, and is unacceptable in some cultures.

Although health promotion to reduce these factors has led to a decline in heart disease in the West, heart disease and stroke remain the most important cause of death and disability worldwide. The increasing obesity that now emerges despite health promotion will make this even worse. *Something's missing*.

Heart disease results from the complex and dynamic interaction of many factors - genes, the environment and the mind. The impulse to adverse risk profiles are embedded in society, culture and customs. Sensitivity – or greater risk than expected from risk factors may be genetic, social or environmental.

The combination of all of these factors in a nonlinear fashion lead us as individuals or communities towards or away from health, with a sprinkle of randomness or chance added for good measure. Understanding how such complex and dynamic influences as the fast food and tobacco industry, media, peer pressure, etc add up to health or disease and how to effect change requires a complexity perspective. It is a dynamic, organic, changing process towards health that requires a similar process towards prevention and risk reduction.

## Ways to Heart Health.

The best way to health is to be flexible; start with *national guidelines*, which are global principles adapted for local context. Adjust as necessary or as per subgroup with better fit. Know your risks and live accordingly, being aware of both obvious and the not so obvious or *hidden risks*. If you belong to a *higher risk group*, then you could move directly to the *more intense guidelines for that group* or start with national and adjust accordingly to arrive there. Novel approaches include.

### *Use the mind to reach the heart.*

Neuroscience and functional brain imaging confirm the complexity of mind brain interactions. Results and insights from such study have been used for marketing and assessing consumer preferences and responses, and could be harnessed for heart health.

### *Use math to reach the heart*

Fractals, chaos and complexity can be used as a more realistic model for health patterns and how things work and change, and to influence feelings and motivation that could improve heart health.

### *Put things in place to make health*

Change the environment to make it automatic or easy to make healthy choices and to engage in heart healthy behaviour. Put things in place that take you and your community towards health, reducing the need for greater motivation and will.

### *Make health the way*

Internalize health as a process of becoming and being rather than something external to aim for. Make health a part of culture, customs and everyday thinking for individuals and communities.

*With this, risk assessment and risk reduction follow the rules of complexity described previously.*

Use ***total or global risk***, from adding up the individual risks ***nonlinearly, to guide*** diet, lifestyle, prevention and treatment choices, noting that clustering of risk factors like the metabolic syndrome ***amplifies*** risk. ***Waist size or weight*** is a good marker of risk, ***except for hidden risk in slim people***. Prediabetes and pre high blood pressure indicate risk and needs risk modification.

Having close ***family members with heart or blood vessel problems*** at a young age (around 50) ***increases risk a lot***.

Heart disease starts younger and is more severe in some communities - Native Peoples, Hispanics, South Asians, people of African origin, and from the Middle East. These groups, and ***children whose parents have early heart disease*** need more intense earlier screening, testing and lower lipid levels.

To assess and change GLOBAL or TOTAL risk  
***Start with diet, exercise and lifestyle choices***

***Then go for lower*** LDL “bad” cholesterol levels  
and higher HDL “good” levels

***If very high risk*** or have heart disease:

***AIM for:*** LDL less than 1.7 mmol/L (70mg/dL)  
and HDL over 1.0-1.2 mmol/L.

arteries probably stop narrowing if LDL is around 0.8-1.2.  
LDL levels in rural India and China are 1.2 – 1.7 mmol/L.

***Should this become our new target?***

Look for nonlinear effects of some risk factors and use them to try for amplified risk reduction.

## Fractals, chaos and complexity in health

Risk reduction will *differ in different countries* and regions, and even in adjacent neighborhoods or houses, depending on culture, customs and other factors. The central features of health promotion remain constant everywhere, however, but the details may differ.

Health promotion is thus like a fractal, self similar everywhere, but with differences in time and space. There is also fractal distribution of disease patterns, crossing boundaries. For instance some ethnic groups have patterns of heart disease excess in pockets within their communities, wherever they have migrated, leading to patterns within patterns of disease distribution.

Health promotion efforts recognizing this reality should prove more effective. Novel approaches such as chaos and complexity, which we have used, should achieve more, in the context of complex dynamic interactions that lead to health and ill-health.

Health is an emergent property of the complex dynamic interactions of various internal and external influences, genetic, environmental and mental, obeying the laws of complex systems, chaos and complexity.

The “strange attractor” of chaos is the outcome to which these interactions are pulled. Healthful choices take you in that direction, but other influences disrupt. A wise approach is thus to know your risks, live by your risks and make choices, “attracted to health.”

It’s also a matter of the intertwining of the simple and the complex.

## Heart Health: the simple and the complex.

***The simple:*** Do the right things to achieve good health. These include simple diet and lifestyle choices, eg. balance eating and exercise to achieve desired weight. We have strayed from this simple advice recently and have become accustomed to, eating too much, eating the wrong foods and exercising too little. Fixing this should be just as simple. Eat a variety of foods in smaller quantities and keep physically and mentally active.

***The complex:*** Its not so simple. The nature of the many complex interactions and influences ensure ***surprise and uncertainty***, as in the rest of nature. Our genes, sensitivities and abilities to respond differ. We thus should do the best we can, knowing that in doing so we have improved our chances of doing well, ***but be prepared for surprise***, which is the nature of things, ***and plan for it***.

Some people do everything right but still get heart trouble, while some who do everything wrong never get ill. These are not just exceptions or chance, or fate, or reasons to dismiss health advice, but the result of chaos and complexity in complex systems, and the probabilistic nature of risks and changes.

How can we achieve health amidst such chaos and complexity? It's a matter of ***choice, chance and change*** for the individual and community, recognizing limitations and uncertainties. Find what works best, and use feedback, adaptation and change to optimize or correct. Find new methods to understand and change, since what we have currently don't seem to work for many of us.

***Go beyond living by your risks.*** Moderation may not be enough. Search for more. Learn HOW not just what to do.

## Make Health the Way.

Think positive, go for health. For some it's easy, for others not so easy. Work with what you have, your strengths and weaknesses.

Look for role models. Meet people who go for health. DO the things they do. Change yourself a bit at a time. Set some realistic goals and enjoy the process getting there.

Learn new things. Search for and find new ways of achieving goals. Explore new and healthy foods from other cultures. Learn new ways of including exercise in daily living.

You don't have to know all the details and worry about all the little things. Keep in mind how nature works, through chaos and few rules. *Make a "few rules" plan, and change as you go along.*

### **Why few rules:**

How do things happen in complex systems? Ever looked at birds in a flock darting about, hundreds of them moving together rapidly changing speed and directions. How often have you seen them crash? Why don't they?

They follow simple and few rules. They don't have to know everything: where every other bird is and their directions and speed. Few rules for them: Don't hit the bird in front. Keep a certain distance from the birds around. And enjoy the flight.

To see this illustrated, please go to this website by Craig Reynolds: or just type in **boids** in Google.

<http://www.red3d.com/cwr/boids/>

## Few rules chaos based health plan

Know and live by your risks, then go beyond. Set goals and move closer to them according to choice or need, adjusting along the way. It's a dynamic balance of influences towards or against health. ***There is no single rule for all, since everyone is different,*** but there are common goals and much that is similar for everyone. Adopt these and adjust to fit your situation as needed.

Previous guidelines and most books promote specific rules to be followed. Use it if it works for you. Go beyond if it does not or if your style is different, and adapt these rules to your own unique situation, recognizing constant change.

A “few rules approach” gives general ideas and targets to work towards. If things change, forget the details - just make adjustments in the appropriate direction. If your weight goes up - eat less and exercise more. If your weight is dropping too much, do the opposite. How much you do depends on how far you are from desired and your motivation. Work on that and think boids.

Life is constant change. Your weight and health is dynamic. You don't have to know all the details and count all the calories. Just a rough idea and then give yourself feedback using guidelines, or make up your own. There are few firm rules, with the emphasis on a process to get you there.

***Health is a complex adaptive system and we have to live by its rules. They are simple and few. Find your risks. Live by them. Move in the right direction, with feedback and change as necessary. Go beyond risks to test and change your health status.***

## Going beyond checking risks

The Association for Eradication of Heart Attack says, “traditional risk factor-based guidelines allow high risk people to ***think they are healthy*** when their heart is ***actually a ticking time bomb***.

We need a new way to heart health and to prevent heart attacks or dying from one - ***screening and treatment, beyond risk reduction***.

### Risk severely underestimated

***AEHA*** (Association for Eradication of Heart Attacks)

- ***Current guidelines misses high risk individuals***
- ***The majority of heart attack victims would be missed by current (US pre 2005) guidelines.***

### ***NEW APPROACH RECOMMENDED***

***enjoy healthy lifestyle choices***  
***find and reduce known and hidden risks***  
***test for usual and newer risk factors***  
***start prevention when young***

***Find out if you ALREADY have heart disease at an age earlier than it tends to occur***

need better method of screening and testing  
 use the newer technology available

***Think nonlinear effects and use chaos and complexity to amplify risk reduction.***

The Association for the Eradication of Heart Attack (*search website*) advocates ***much more aggressive screening and treatment*** than currently offered.

Since current guidelines underestimate risk, how do we identify those among us with a ticking time bomb, and how do we prevent getting there?

Exercise tests are very good but sometimes wrong. They can usually identify people with serious heart disease, but cannot identify those with small narrowings, which often are the ones that rupture and cause the sudden heart attacks. Newer tests like C Reactive protein, Lp(a) and homocysteine, etc identify higher risk, but it is uncertain if or how much treatment reduces risk. Things change fast and you need to discuss this with your doctor.

### ***The AEHA proposes***

#### ***Risk reduction for all.***

***Intense medical therapy and lifestyle modification if high risk. Advanced pre-emptive interventions*** (term used on the website for surgery, stents, and medications to reach new low cholesterol levels).

I would add: Keep probabilistic thinking in mind when choosing how much or what to do. Risks are probabilistic and can fail. Know this and use a chaos and complexity science probabilistic approach to help make decisions, using the best evidence in context.

## Where to learn more?

Everywhere: newspapers, magazines, books, newsletters, consumers' organizations, heart health organizations, **and increasingly the web.**

Seek **reliable** web sources, such as Professional Organizations, National Heart Health Organizations, University sites, etc.

American Heart Association

American Diabetic Association

AEHA: Association for the Eradication of Heart Attack.

SHAPE: Screening for Heart Attack Prevention and Education

NCEP: National Cholesterol Education Program

Heart and Stroke Foundation of Canada (and provinces)

*We are not made for the fast paced, stressful environment with easily available food in large quantities plied to us, and with increasingly less need to walk or exercise.*

*We have to deliberately counteract those influences to maintain a lifestyle to protect us from them, and make healthy choices part of daily living for ourselves, and our community.*

*We know WHAT causes heart disease and what to do for prevention. We need to learn HOW to make it work in daily living.*

*We have to learn how to overcome the adverse influences, especially for children, and learn how to ENJOY HEALTHY LIVING*

*Having taken care of that, we then need to assess our overall risk, and then live according to our risks.*

## NEW US Food Pyramid 2005

***Make up your own or could start here.***

*(search websites for 2005 new food pyramid)* to provide healthy eating guidelines and for better health and to deal with the increasing obesity and diabetes in children and adults. It makes weight the target and marker, and ***directly links healthy eating and exercise*** by advocating a balance of caloric intake with calories burnt on exercise. The principles remain, but this should be ***adjusted for different countries, custom, culture, context, etc.***

***Physical exercise:*** adults 30 minutes per day, children 60.

For weight loss or to maintain weight loss: need to do more - 60-90 minutes of moderate to vigorous activity ***per day***.

***Fruits and vegetables:*** 4-5 cups per day rather than servings.

***Carbohydrates:*** whole grains and fiber-rich fruits and vegs.

***Sugared drinks*** (juices and soda pop) should be limited.

***Fat*** should be less than 20-35% of total calories.

***Transfat and saturated fat:*** as low as possible

***Saturated fat:*** less than 10% of total calories.

***Treats and snacks:*** allowed ***within*** the total calorie intake.

***Calcium:*** 3 cups low fat or fat free milk or equivalent per day,  
children 2-8 years: 2 cups.

Needs: Average active adult male: 2500 calories per day, female 2000.

100 more calories per day than you burn (half a can of soda pop)  
becomes 12 extra pounds per year.

Note: think cups to measure size not servings as before (which was unclear - a large apple is 2 servings, not one as we would imagine).

<http://www.health.gov/dietaryguidelines/dga2005/recommendations.htm>

<http://www.healthierus.gov/dietaryguidelines/> for more details

## Random tips for best health.

Enjoy eating a variety of foods, in small amounts.  
 Eat light, especially at gatherings and celebrations.  
 Less juices, soft drinks and alcohol, since empty calories.  
 Avoid fast food. Everyone knows why.  
 Resist advertising to eat or drink more or to supersize.  
 Resist the urge to eat when you see or think about food.  
 Small portions. Leave rest on plate. Take home extras.  
 Make healthy snacks, especially for children.  
 Make exercise part of your daily routine.  
 Find ways to avoid or reduce stress.  
***Maintain desired weight and waist size.***  
 Don't accept increasing size or weight as natural.  
 Make small adjustments early with continued feedback.  
 Learn from people who live healthy.  
 Copy what they do.

### ***What stops us from doing these things?***

*Mostly social influences, peer pressure, too busy, the mind, etc.*  
***Anticipate such influences and plan for them in advance.*** Design things around you to make healthy choices easy and automatic. Build these into day to day living. Have some fixed rules and some flexibility. Learn how your mind can be influenced and then train it for healthy choices and to bypass adverse influences.

Following Deepak Chopra's idea for peace in his book *Peace is the Way*: Make health the way - one person at a time. Put things in place to make healthy living easy, desirable and automatic, for yourself and others. The real work for health is won one person at a time, towards a tipping point and by community efforts to put things in place to make change easy.

## Global heart health.

- Globally, heart disease is a big problem.
- One third of all deaths globally is from heart disease and stroke (17 million per year).
- By 2020, heart disease and stroke will become the leading cause of both death and disability worldwide.
- The old stereotype of cardiovascular diseases affecting only stressed, overweight middle-aged men in developed countries no longer applies
- Today, men, women and children are at risk and 80% of the burden is in low- and middle-income countries.
- Heart disease and stroke not only take lives, but also cause an enormous economic burden.
- The burden of heart disease in developing countries impairs economic development.
- Heart disease in women tends to be neglected globally.

(adapted from WHO and other web sites)

Heart disease patterns and risk differ by geography, country, ethnicity, socioeconomic, education and other subpopulation variables, in fractal patterns. There are also diasporic patterns, which transcend the boundaries listed above. Suggestions:

1. Follow National Guidelines of heart health for all.
2. Add diasporic or subpopulation specific advice.
3. Ensure that risk is not underestimated by inclusion in a lower risk group.
4. Adapt global “healthy living” practices to local context.

## Women's heart health

*Heart disease in women is different. Ongoing research identifies differences in prevention, treatment, presentation, response, etc.*

1. Start with the usual advice for everyone. Women do get heart disease and die from heart disease more than from anything else (in developed countries).
2. Assess risk carefully: Heart risk in women is often underestimated (and in men too).
3. Don't wait for symptoms. More than half of women who die suddenly of heart disease have no prior symptoms.
  4. Seek medical attention if typical symptoms.
5. Don't ignore unusual symptoms. Seek advice if unwell. Women need to be particularly careful, often with different, unusual or no symptoms.
  6. Seek prevention. Attend to risk factors. Women have greater risk for heart than breast cancer, etc.
7. Be more careful in diagnosis, since tests sometimes not reliable.
  8. Ensure get procedures and treatment needed.
9. Seek rehab if heart disease: useful and often neglected.
  10. Think heart and enjoy heart healthy living.

If you **Google** "**Women Heart Health**" you will find 28,600 entries (July 2005), attesting to the importance of this subject.

There are many organizations and agencies across borders that are now involved in **women's health** and women's heart health, including the major Heart Associations.

Please search their website for more info or select from Google, eg - Heart Healthy Woman, **Women's Health Hot Line**, etc.

A sample to show what exists is:

<http://www.sistertosister.org/>

Sister to Sister, a national grassroots nonprofit organization, exists solely to bring free heart disease screenings and "heart-healthy" prevention information and support to all women in order to prevent heart disease, the number one killer of women today.

<http://www.womenheart.org/>

The National Coalition for **Women** with **Heart** Disease. Providing information and resources related to cardiac **health**, coronary disease and preventing **heart ...**

Search web for S Anand, Eli Lilly/May Cohen Chair in Women's Health Research at Mc Master University, for pioneering research on women's health and ethnicity and health.

For a novel approach on complexity and women's health: search ***femmefractal.com*** with links.

*South Asians across the diaspora, despite their tremendous diversity, have **more diabetes and heart disease** than many other communities, and it starts earlier and is more severe. A complexity rethinking has been used to understand this and for prevention and treatment in the South Asian and other communities.*

Insights and recommendations from this experience likely also apply to all individuals and subgroups with early and more severe diabetes and heart disease.

*A global collaborative complexity type effort has emerged and selforganized to deal with this global issue.*  
Search web for resources.

# South Asian Heart

*the simple and the complex*

Essay: South Asian Heart: Another Enigma of Arrival.

after VS Naipaul's novel *An Enigma of Arrival*)

available at GOPIO web site (Global Organization for People of Indian Origin)  
search under publications

We all need to do more for heart health.

South Asians need to do even more.

Make this your opportunity for change

*New 2007 - why South Asians get more heart disease.*

*Risk Factors for Early Myocardial Infarction in South Asians Compared with Individuals in Other Countries (INTERHEART Study) JAMA Jan 17, 2007. P Joshi et al*

*A large international study across South Asian and many other countries, showing the value of **global collaboration** and research and the importance of reducing the usual risk factors.*

*New 2007 - why South Asians get more diabetes.*

*Complex, but put simply, from susceptibility plus weight gain.*

*"We are all overweight" Salim Yusuf says while discussing the DREAM study. Problem is social environmental that promotes eating more and exercising less than our ancestors, leading to systemic changes.*

*Solution is individual and much more so, community collaboration to institutionalize policy and processes, etc to turn this around. Simple and complex, so a complexity approach is now needed.*

***People considered low risk by Framingham or usual methods, may already have heart disease.***

*You may have heart disease, diabetes or prediabetes without knowing it. It is that simple, but also complex. Current risk assessment tables underestimate risk in everyone, especially in South Asians and some ethnic groups. New strategies are being devised to overcome these problems and ethrisk tables are being developed for individuals and communities*

*Of 100 “low risk” women – 32 had “significant” subclinical atherosclerosis. (National Review of Medicine, Jan 2006, from American Heart J Dec 2005).*

*Family history is a good predictor.  
45% increase risk if sibling has early heart disease*

***BUT risk assessment is not enough. We need to search early for disease and then do something about it.***

South Asians have more glucose metabolic abnormalities like insulin resistance, and thus likely more blood vessel damage, with less abdominal obesity and at lower blood sugar levels than others, starting even in childhood.

Prediabetes for others may already be diabetes for South Asians and some ethnic groups?

*Search web: **Heart Disease South Asian** for much more.*

***Web and other references: Heart Disease in South Asians***

**Free book:** South Asian Heart in Tsunami Chaos Global Heart: VS Rambihar. <http://www.femmefractal.com/tsunami.htm>

**Free Book:** Prevention treatment and Rehabilitation of Cardiovascular K Disease in South Asians [http://www.sahf.org.uk/Full\\_text\\_version.pdf](http://www.sahf.org.uk/Full_text_version.pdf)  
K Patel A Shah 2005

South Asian Health Foundation (UK) <http://www.sahf.org.uk/index.html>

South Asian Heart Center <http://www.southasianheartcenter.org/>

**Book** How to beat the Heart Disease Epidemic among South Asians: a prevention and management guide for individuals and their doctors. E Enas. Chapter 1 ***free preview***  
[http://www.cadiresearch.com/book\\_preview\\_b.html](http://www.cadiresearch.com/book_preview_b.html)

<http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijc/vol1n2/cadi.xml> Enas A Enas, Annamalai Senthilkumar: Coronary Artery Disease In Asian Indians: Update/Review. Internet J Card “01. Vol1 # 2.

<http://www.cadiresearch.com/illustrated.htm> CADI Research Foundation: Coronary Artery Disease in Indians

<http://www.aapimsr.org/Diabetes/cad.htm> American Association of Physicians of Indian Origin

[www.epi.bris.ac.uk/CVDethrisk](http://www.epi.bris.ac.uk/CVDethrisk) ***web risk tool for South Asian and other ethnic groups, UK. Use as a guideline elsewhere. “ethnic groups in the UK have been wrongly assessed and this new tool more accurately reflects true risk.”*** Primary prevention of cardiovascular disease: a web-based risk score for seven British black and minority ethnic groups. *Heart* 2006; Brindle P, May M, Gill P, et al. DOI:10.1136/hrt.2006.0902346. available at: <http://heart.bmjournals.com>.

*This is a remarkable story that has unfolded over the past 45 years - of high rates of diabetes, heart and blood vessel disease across the entire widespread South Asian diaspora. The patterns are self similar but not identical, related to sensitivities and the dynamic interplay of initial differences and local factors acting at the social and biologic level. There are patterns within patterns on deeper examination, with some inhomogeneity.*

*This elegantly illustrates chaos and complexity at work, with similar emergent phenomena despite tremendous diversity of origins and complex dynamic interactions that lead toward and away from health. Chaos and complexity provides a novel perspective used by this writer since 1990 to explain this and to achieve change and health promotion in this and other communities. It introduces the novel concept of **fractal distribution of health patterns** and a novel approach to dynamics and change.*

South Asians, people whose ancestry is from India, Pakistan, Bangladesh, Sri Lanka and Nepal have migrated widely to create a diverse diaspora, with extensive further remigrations. They arrived at their respective new homelands for a variety of reasons, the historically defining migration being after the abolition of slavery August 1834, when Indians were taken abroad as Indentured Labour to work primarily on sugar estates and tea plantations.

They came from different parts of South Asia and went first to Mauritius in 1834, then to Guyana 1838, Trinidad 1845, Assam 1859, Natal 1860 and Fiji 1879, ending up all over the world. Later migrations after Indenture was stopped saw Punjabis move to California and BC, Canada around 1900, with larger SA migration from other areas to Europe, Canada, and the US in the 1980's.

There are about 10 million in this diaspora today, in almost every country, roughly 3 million each in the UK, USA and Canada, with a tremendous diversity of culture, customs, religion, food and habits and a wide diversity in social and economic situation.

My great grandparents traveled from India to Guyana across the dreaded Kala Pani sea to plant sugar, while one of my wife's grandparents came from Fiji. They lived as "East Indians" in Guyana (then British Guiana) alongside British, African, Chinese, Portuguese and Aboriginal peoples. I was born and grew up on the coast of Demerara, Guyana, attended Queen's College high school, teaching math before leaving for Canada to study medicine, with no medical school in the country then.

Practicing cardiology in Toronto since 1980, I became exposed to the multicultural diversity of Toronto and the wide diversity of South Asians from all parts of the world. As the first South Asian community cardiologist in Toronto, responsible for one of the largest number of South Asians with heart disease in North America, I observed the same pattern of early and excess heart disease previously described in the UK and across the diaspora.

Our research (early 1990's) confirmed that in Toronto South Asian patients had heart attacks at a much younger age than Chinese and whites, which stimulating our awareness and change project. (A recent large international study - JAMA 2007, Joshi et al with Dr S Yusuf confirms this for heart attacks in South Asians in South Asia, showing the reason as higher levels of usual risk factors).

Knowing this community well and sensing the importance of complex dynamic social and biologic interactions, *I found it useful around 1990 to **rethink this problem in complexity terms** and to devise health promotion as complexity based.*

***With no literature or experience on this at the time, we had to make it up as we went along.***

## South Asian Heart

*First reported in 1959 by Danaraj, from research in Singapore, a pattern of excess and early heart disease is now recognized wherever South Asians have migrated. Dr Mohan Ragbeer, former Dean of Medicine at the University of the West Indies, also reported this at a conference in Trinidad in the West Indies in 1961, likely the first such observation in the West. I learnt about this subject from a 1987 article in South magazine, and from medical reports in the UK in the 1980's, leading to our South Asian Heart Health diaspora project, launched at a Conference at York University in Toronto in 1990.*

As in all communities, there is tremendous diversity among South Asians, many living long and healthy lives. The challenge is to **identify those at risk and to start prevention early**. It is thus important to **encourage all** South Asians to **healthy living** and to target the community all across the diaspora for increased awareness and earlier screening, prevention, testing and treatment. Since much of heart disease and diabetes is related to diet and lifestyle choices, a concerted effort to change the aspects of culture and customs that impair health becomes necessary.

***South Asians develop heart disease and diabetes for the same reasons as anyone else - the complex and dynamic interaction of genes, the environment and the mind.***

The higher rates may be due to more South Asians with genes for heart disease, or a **greater sensitivity** to the environment, especially to adverse lifestyle choices on migration or on moving to cities. The newer lower cholesterol and blood sugar targets for all are

closer now to the very low levels found in people in rural areas of India and China, who have low rates of such diseases.

The observation is not unique to South Asians. The diasporic scattering of South Asians and their strong retained culture and customs may have contributed to easier and earlier recognition of a pattern of response to environmental stresses common to all communities, with possibly different sensitivities and susceptibilities.

High rates of diabetes and heart disease have been widely documented in the Native peoples across the world, in Hispanics and people of African origin in the US, and people in emerging economies such as Russia and Eastern Europe. Undoubtedly, with the tremendous diversity of people world wide, there will be similar disparity in rates of heart disease and diabetes that will challenge our ability to achieve prevention.

There is increasing lifestyle diseases among all people, from the fast-paced lifestyle and westernization of culture. This includes people from around the Indian Ocean affected by the tsunami, and the total health of everyone remains important after the tsunami.

**Obesity in adults and children across the world is increasing**, leading to even earlier *blood pressure, diabetes, heart disease, and many other illnesses*.

Although much worse in the West, this is *increasingly seen in developing countries and is being described as an epidemic in the making*. It could devastate the

economies of developing countries in the tsunami stricken areas as across much of the world, much more than the tsunami did.

The reason for this, as in most things, is both simple and complex. Simply, we live fast paced, eat more than we exercise and respond poorly to the increasing stresses we face. Fixing it simply means reversing these things. It clearly is more complex than this, with ***socioeconomic and many other determinants of health***. Learned and acquired behaviors and ingrained aspects of culture and customs that impair health are often difficult to change, etc.

There are global and local efforts to reverse this problem. These require usual and novel approaches. A fractal and chaos and complexity perspective or model may be useful. There needs to be a common theme and policy based on scientific evidence, modified by local circumstances or context.

Differing approaches may be required within different groups to achieve best results and the approach should be multi-directional. Change should be allowed to emerge from the self-organization within communities in addition to central policy directed. Creativity, ingenuity and imagination should be encouraged in seeking change, as reported in our book chapter in *Complexity and Healthcare Organization*. Radcliffe Medical Press, Oxford, 2004.

***The higher rates of heart disease in SA may be mostly from the chaos and complex dynamics, and the sensitivities and risk amplification of known risk factors, which open new thinking for prevention.***

## Risk severely underestimated for ALL

including South Asians and some other groups,

who may have even greater risk

*So for South Asians and these other groups*

***Follow the AEHA aggressive guidelines for all***

*note*

AEHA (Association for Eradication of Heart Attacks)

- ***Current guidelines misses high risk individuals***
- ***A large percent of heart attack victims would be missed by current (US) National Guidelines***

***Start prevention when young***

***Find out if you ALREADY have heart disease at an age earlier than it tends to occur***

WHY?

***Studies have shown more severe disease in South Asians and other groups, for the same level of risk factors.***

## South Asian Heart project

Started in 1990, this project arose from our *observation of high rates of heart disease* in the growing South Asian community in Toronto in the late 1980's and the desire to change this. It broke new ground, discussing a subject not considered acceptable at the time. The project expanded to a wider Diversity and Health, and Ethnicity and Health initiative, taking the opportunity to explore further observations and the disparities increasingly reported. This is now becoming essential and mainstream thinking, with a critical mass of research evidence and increasing interest in the importance of cultural competence.

Because of such challenges, we sought novel methods to achieve change. By chance, I became aware of the new science of chaos and complexity around 1987, after reading James Gleick's landmark book on chaos, and intrigued, followed up by reading everything I could find, which was not much in those days.

I sensed that there was a *novel change theory* within this chaos that may be much more powerful than anything before and designed this into various projects, including the South Asian Heart project. Instead of pushing for more of the usual top down directives to change the community, we encouraged a self-organizing, grassroots community project, with strong and weak links across the diaspora as far as we could reach.

The results were tremendous, and the experience and insights were presented at various international conferences and reports, including as a book chapter by this author in *Complexity and Healthcare Organization* (Radcliffe Press, Oxford, 2004).

*South Asians have tremendous retention of tradition and customs, meaning greater resistance to change.*

*The diet is often traditional and even if vegetarian is often high in saturated fat, carbohydrates and sugar.*

*There is a tendency to accept an enlarging waistline that comes with middle age as inevitable, with reluctance to be physically active.*

*Women tend to avoid exercise, partly cultural and partly to avoid exercise in the presence of men.*

*South Asians have many holidays and festivals and thus more opportunities to celebrate and eat more.*

*Many South Asians eat little all day and then too much at night to make up, leading to greater obesity.*

*Compared to Chinese who have low (but now increasing) rates of heart disease, SA tend to drink less tea, add milk to tea which may inactivate beneficial antioxidants, eat less fish, eat more saturated and deep fried foods and probably boil all the vitamins out of vegetables.*

*SA have more of the blood factors that cause blood clots, and more tendency for diabetes for the same waist as other ethnic groups.*

## 2006 South Asian Heart Guidelines

### Start with National Guidelines for ALL

- *Adjust for local context or your situation*
- *Enjoy heart healthy living from childhood*
- *Assess risks early and change for better health.*
- *If high risk, search early for heart disease*
- *Seek lower targets if increased risk, especially if early family history, diabetes or high blood pressure*
- *Establish routines to make it easy to remain fit and slim for life*

### Then do more than recommended

- Multiply calculated risk by 1.5
- **Or** add 10 years to patients age in calculating risks
- **Or** treat at a lower risk level
- **Or** treat all SA as if they have diabetes, with new specific guidelines being developed
- Seek more intense treatment and prevention
- Seek lower targets than usual guidelines
- Try to keep as flat an abdomen as possible
- Try to remain fit throughout life
- Reduce other risks even more than usual

*Adapted from the South Asian Health Foundation Workshop Sessions UK, December 2005, various websites, and derived from the literature and ideas from my practice.*

## Why different guidelines for South Asians and other ethnic groups?

Current guidelines ***underestimate risk*** and disease in ***all populations*** (See AEHA website)

Current recommendations are based on population data without or with few South Asians included

Current prediction models do not reflect the real risk faced by some ethnic groups and thus do not apply

Risk assessment and risk reduction models are being developed for South Asians and other groups

Until then, we need to adopt a reasonable approach, awaiting research evidence

***Genomic medicine*** will increasingly become available to refine and design prevention and treatment

***Despite this, we still need to use the usual as well as other identifiers of risk, including ethnicity***

Targeting individuals and communities at risk, is and will remain important for increased prevention

Use a complexity approach, find out what's known, work with the nonlinearities and uncertainties, anticipate, and change now for better health for the individual and for all communities at risk

***South Asians do not do enough for heart health as individuals or as a community.***

*Many of us just look on while others adopt heart healthy lifestyles. We claim tradition and customs and maintain heart unhealthy habits. **We need change.***

***Rethink heart:*** *We need to understand the complex dynamics and interactions involved at the various levels that lead us towards heart disease, and then make appropriate changes as individuals and to the community. Severe heart disease can have no warning or symptoms and can happen despite being slim, fit or exercising and eating well. Thus we need to search and test for heart disease while testing for and treating risks and seeking prevention.*

***There needs to be a rethinking across the entire community,*** *along with action for change. We need to do many things differently. For instance, we should use South Asian social occasions to promote heart health and 2 minute heart. Community meeting places such as temples, etc should become centers for health and health promotion, with religious and community leaders involved. We should lead by example, showing **our** heart healthy choices, insisting on healthy options for meals and snacks, showing children how to live healthy and make it a **New South Asian tradition of heart health.***

### *Ethnicity and Health*

I was invited to lecture in Martinique on Heart Disease in the South Asian community, to transfer lessons learnt elsewhere to this French island in the Caribbean. My daughter Nadira translated for me and delivered part of the talk.

South Asians have settled widely across the world, in an earlier migration, as indentured labour to the sugar plantations in the colonies, including Martinique and Guadeloupe. High rates of heart disease in this community were not discussed, since by French custom, derived from *liberté, égalité and fraternité*, ethnicity and health discussion by citizens was dissuaded. I was invited to speak after a lecture at the Caribbean Cardiac Society Conference in Barbados. I did mention in my talk that it seems that the only race in France is the Tour de France.

Ethnicity and health research has become topical and subject to debate. Many people feel that other and better determinants can be found to address evident health disparities. A converse argument is that disparities related to culture, customs and other social determinants associated with ethnicity or race should be addressed directly, recognizing possible sensitivity to and increased prevalence of heart disease genes in subpopulations.

It is complex, with complex dynamics of social and other determinants taking us as individuals or communities, towards or away from health. A new millennium thinking from chaos and complexity science may be useful.

I think the next century [21<sup>ST</sup>] will be the century of complexity.

Stephen Hawking, 2000

## Millennium Heart

# Millennium HEART

*(from Vol 2 of Chaos from Cos to Cosmos: Making a New medicine. A New Chaos Based Medicine Beyond 2000: with permission)*

*I wrote this 2000 word essay at the turn of the millennium to remind us of the interdependent world we live in, and that our involvement can take different paths. Just being interested and talking can be important, since some day it may translate to action or influence someone else. Small actions locally may amplify globally and make a big difference.*

New meanings, models and metaphors may be needed to illustrate these ideas, and I have drawn from the new science of chaos and complexity to achieve this.

It introduces the concepts of fractals, chaos and complexity as important to understanding and making a better world.

The 2004 tsunami and the global response illustrate these ideas well.

A tsunami is also fractal, born of a scientific chaos and causes another kind of chaos.

# Millennium HEART

*HEART @ 2000:*

*Of meteor showers and butterfly metaphors.  
Choice, Chance and Change for a Fractal World*

*By Vivian S Rambihar MD*

Einstein declared that if we know everything about a grain of sand, we would have explored the universe. William Blake expressed this more poetically:

*To see a world in a grain of sand, And heaven in a wild  
flower,  
Hold infinity in the palm of your hand, And eternity in an  
hour.*

As physicians, we practice an art and science, combining facts acquired, with experience gained. Unsettled daily by the uncertain and the unexpected in my practice of cardiology, I wandered endless journeys and unknown perils through diverse fields in search of answers, returning often to the place I started from, seeing the world with transformed eyes. I discovered a new art, science and humanity in Blake's grain of sand in Einstein's universe, or is it Einstein's grain of sand in Blake's universe?

Exploring heart disease draws us deep into the mysteries of the universe. We gaze in awe and wonder. But not for long. Another infarct, another cardiac arrest and everything comes crashing down again. People appear from nowhere, galvanized into furious action

to save a life, to wrest a soul away from eternity. A single heart beat breaks, a flicker and then a flame, and life is lit again.

We call it VT or VF, but the patient calls it impending death. We see cells and molecules and rhythms and blood flow. The patient and family see a person, a husband or wife, son or daughter, friend or foe, with, according to Robert Frost, miles to go and promises to keep before they sleep. Our quest is not to fix disease but to help people in their miles to go and promises to keep. René Dubos illustrates this when he says that the role of medicine is to help man function well in all his endeavours

We seek explanations from science and plumb the world's knowledge like shamans of old, to ply modern medicaments and ancient cures in this quest. Twenty-five hundred years after Hippocrates walked the shores of Cos, we are still left often with no better explanation than "Things happen. Sometimes things just happen." In modern parlance we claim "the play of chance" or "random walk" to describe the uncertain, unpredictable and unexpected we so often encounter.

About twenty-five hundred years ago also, Democritus of Abdera, more famous for deriving a particulate theory of matter by smelling fresh bread as he opened his front door, claimed that "everything happens through the agency of chance and necessity." More recently, Pascal confused the issue by stating "the heart has its reasons which reason does not understand."

Should the facts we have now collected not enable us to understand why people get heart attacks, and how to prevent them? Has science not advanced enough to be able to predict when and where and under what circumstances these will occur, affording us

the opportunity to avert adverse outcomes. If so, then why do we still face statements from patients and their families such as “but she was doing so well” or “but he was just given a clean bill of health.” Or are there limits to what science can achieve, despite our resolute reductionist approach of dissecting everything into finer and finer detail answering ever increasingly complex questions?

Answers take us into a meandering journey through adventures into the simple and the complex. Patients are not machines where everything fits neatly into place like Newtonian cogwheels. They exhibit ever-changing complex dynamics interacting with feedback with their internal and external environment. Small changes may create disproportionate outcomes in systems with interconnectedness and nonlinearity, yielding the variety and variability we observe and the surprise that leaps out in every clinical encounter. In every patient and every encounter resides the mysteries of the universe.

These ideas represent a new thinking in science emerging from the post-normal science of chaos and complexity revealing new meanings, models and metaphors for a new millennium. The play of chance or randomness is not the only reason for the unexpected. Sometimes surprise is built into the system, emerging as a natural consequence of the order of things. The simple and the complex, and order and chaos are intertwined everywhere. *Fractals* describe self similarity at differing scales. *Strange attractors* illustrate strange unpredictability with outlines revealed but details uncertain. With *sensitive dependence* small changes or omissions in input change outcomes disproportionately. *Self-criticality* describes sudden bifurcations, and *emergence*, the natural self-organization towards outcomes.

Charles Darwin may have had even far greater insight than he is given credit for when he said “the eye is a chaos of delight.” Chaos has been implicated in the evolution and the origin of our species and even of the cosmos. Features of chaos abound in nature. This nature does not abruptly stop when we reach human scale. Typhoons, tornadoes, tempests and turbulent seas erupt throughout the body incessantly. The same laws that govern the external world should also apply at various levels in the body, leading to chaos in the coronary.

Coronary artery disease is nonlinear - developing in a stuttering fashion, depending on a myriad of local and distant influences, with risk factors variably affecting the outcome. Heart disease is a strange attractor, with the details uncertain, because of the ever-changing influences of numerous interacting factors taking us toward or away from CAD.

Heart attacks illustrate chaos in the coronary. Complex cascades or interacting systems at various levels interact with the internal and external environment to affect a vulnerable plaque which then ruptures as a bifurcation point in history. Progression or dissolution towards or away from a clinical event develops, the direction ever-changing at any instant. If an infarct with cardiac arrest emerges, another type of chaos breaks out in the coronary, with everyone galvanized into furious action.

Is it any wonder that we cannot predict accurately the outcome of complex systems any more than we can predict the weather a week hence? It was Edward Lorenz, an MIT weatherman who by accident, chance or serendipity let his old computer run when he wandered off for coffee in 1961, revealing a different weather

forecast if he omitted a decimal place of data in the input, discovering the now famous *Butterfly Effect* of chaos.

A black box of causation separates inputs from their expected outcomes. This Pandora's box opens to reveal chaos, with butterflies flitting around touching everything. There is usually no single cause of an outcome, but rather interacting contributing factors, some more than others. Averting adverse outcomes should thus not be directed at finding a single cause, but at all possible contributing causes.

We know to expect surprise with heart attacks. Mandelbrot, the discoverer of fractals, says that "on even the calmest sea, a gale may be just over the horizon." These gales are caused or prevented by the fluttering butterflies. Lorenz, the co-discoverer of chaos with Ueda and Mandelbrot, claims that "a butterfly flapping its wings in Brazil causes a tornado in Texas." He is quick to point out the converse, however, "a single flap of a butterfly's wing could also prevent a tornado which would have formed."

It is thus no wonder that we cannot accurately predict the details of heart disease or heart attacks. This does not mean that we stare hopelessly and helplessly as events transpire, and that everything is up for grabs. Quite the opposite. Chaos and sensitive dependence give us the lever to shape the world, and open the window of opportunity to make a difference. We can offer "strange predictability" based on risk factors and other variables, but the inevitably omitted details dictate uncertainty in outcomes and create anticipated surprise, which we can then deal with emergently.

In this dynamic, how can we then hope to restore any order in our practice of medicine? After all, medical decision making is predicated upon our ability to predict the future. If we do not like what we see, we intervene, presuming that this yields our patient a better future. ‘Primum non nocere’ admonishes us to do no harm, presuming that we can tell what harm we may cause. This should now be updated to read “do less harm,” since everything we do may cause some harm, expected or unintended.

One response draws us further into reductionism, desperately seeking certainty. The current appeal of evidence based medicine resides in its reliance on scientific methods of acquiring data and transferring them to individuals and populations. The individual may lie anywhere in the spectrum of variance, however, and thus not be fully representative of the evidence base. This difference in initial conditions exposes the individual to unexpected outcomes. Evidence based medicine does not yield certainty for the individual.

But it is the best we have. Practising the art and science of medicine requires that we do something, rather than sit idly by like the Lotus Eaters of old gazing at the universe passing by. We practice the best medicine, using the best evidence in context, recognizing its limitations and the potential for surprise. We should anticipate uncertainty and plan for it, being ready to change course rapidly. We can use chaos to metaphorically and philosophically bridge the gap between evidence and the reality of the individual.

We should recognize the power of small initiatives in creating desirable change, and avert impending dangers which loom ahead, sometimes requiring large changes but at other times only gentle nudges or gentle shifts. Carl Sagan illustrates this with his meteor

metaphor. He says that occasionally meteors approach the earth on a collision course, and that NASA has even seriously considered sending astronauts to board these heavenly bodies to gently nudge them away to avert apparent impending and inevitable catastrophe.

Meteors have lasting impact. Jurassic Park introduced us to the consequences of an unexpected meeting of a meteor and the Yucatan Peninsula sixty five million years ago, decimating the dinosaurs and paving the way for our existence. There is even now a heavenly body, a 22 kg of rock called *433 Eros*, chaotically wobbling its way towards a meeting with us within two million years, but we're told, not earlier than one hundred thousand. At least the danger is not imminent. We can live with this uncertainty.

Meteor showers and butterfly metaphors have lessons for heart, medicine and humanity. We can foresee impending dangers at the individual level in risk factors for heart disease and do something about them. There is a graded response and every little counts. On a global scale we anticipate exporting coronary artery disease to less developed countries and communities through adverse diet and lifestyle changes and cigarette smoking. With impending danger looming ahead, it seems wiser to act now to avert unnecessary disease, death and debility, than to react to epidemics or catastrophes.

Intended and unintended consequences ripple across time and space in this increasingly interconnected and interdependent world. We are affected by what happens far away and can also impart influence at a distance. We need not walk the ends of the earth to make a difference. We hold the lever to shape the future from wherever we are.

Our telos as physicians caring for humanity, is to help everyone with whom we share this insignificant and transient speck of interstellar dust called earth, to their promises to keep and their miles to go before they sleep. What we need to achieve this as we traverse 2000 is heart, and an understanding of meteor showers and butterfly powers.

The appropriate way to close this meandering essay, spun with new ideas emerging towards 2000, is to defer to the poetic beauty of Edna St Vincent Millay's words,

*Upon this gifted age, in its dark hour,  
Falls from the sky a meteoric shower  
Of facts....they lie unquestioned, uncombined.  
Wisdom enough to leech us of our ill  
Is clearly spun; but there exists no loom  
To weave it into fabric....*

As we begin a new and gifted age, beyond 2000, we have facts unquestioned, uncombined. We have the loom, but do we have the wisdom to weave a fabric of humanity?

## Other millennium writing or thinking

Ralph Abraham writes in *Chaos Gaia Eros* about these three streams of history converging around 2000.

Stephen Hawking said in 2000 that he thinks this century is the century of complexity (derived from chaos science).

*Chaos 2000: A new science for Nursing for a New Millennium*, presented by this author and colleagues at an International Nursing Research and Utilization Conference at the University of Toronto in 1997 and also at a Nonlinear Dynamics in Nursing Conference at Rush University in Chicago, and published in *Complexity and Chaos in Nursing*, Summer 1999.

*Chaos 2000: Women, Diversity and Heart Health*, by S Rambihar and colleagues was presented at The First International Conference on Women, Heart Disease and Stroke at Victoria BC, Canada in 2000.

*Chaos 2000: From Cos to Cosmos: Making a New Medicine for a New Millennium*, a book by this author and the follow-up *A New Chaos Based Medicine beyond 2000: the response to evidence*.

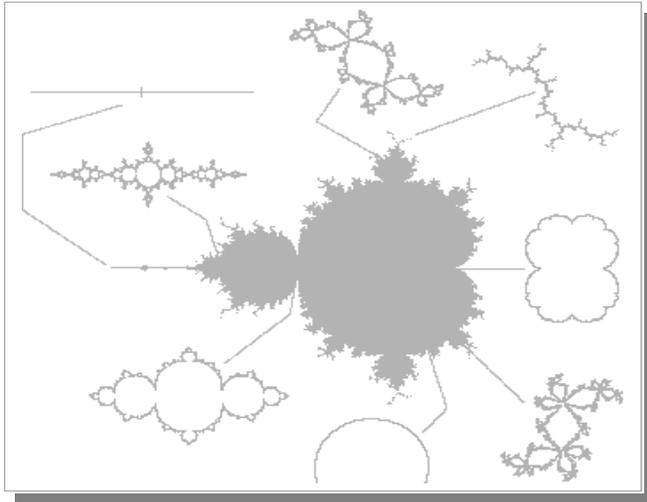
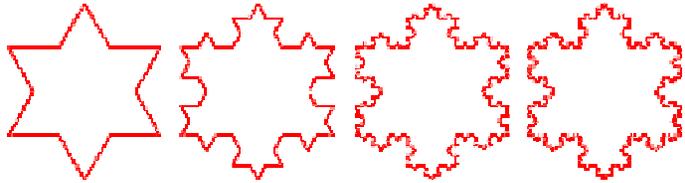
*A mathematical (chaos and complexity) theory of medicine, health and disease: refiguring medical thought*: Please see Appendix: Ideas from this presented in 2000 at Trinity College, Cambridge University, UK and at the Newton Institute for Mathematical Sciences, Cambridge, UK.

The word *fractal* was coined by Benoit Mandelbrot to mean both fractured (broken and a part) and fragment (broken and a part of the whole) at the same time.

*Fractals, chaos and complexity provide new meanings, models and metaphors for identity, diversity and our complex dynamic interactions, which empower each individual and each group in our local and global diversity,  
and  
in our fractal world in a land of complexity,  
or  
our fractal land in a world of complexity.*

There are different degrees of diversity within diversity, each potentially infinite, similar to the multiple infinities of Cantor's sets in mathematics or as seen in fractals. Each person or group is complex with everchanging patterns within. When examined more deeply or broadly, more detail is revealed, with some similarities but differences, creating identity and difference at the same time.

# Diversity Fractals Heart



## Diversity as FRACTAL

There is tremendous and everchanging diversity of all kinds in all parts of the world. The future of the world depends on such diversity for growth, evolution, innovation and change, especially when it includes diversity of ideas and multiple perspectives.

Diversity, however, can lead to conflict, beyond healthy competition and cooperation, and risks consuming the world. Ethnic conflict is rife around the world and rears itself more at times of stress and competition.

It is our challenge to overcome this and use diversity as a positive force for making a better world. *Perhaps rethinking diversity as fractal could restart this process.*

Imagination and creativity emerge from diversity. It is at the interfaces of difference where there is greatest tension, which can become creative. Most of the greatest ideas in the world are born of this creative tension and turmoil.

Diversity does not have to divide. *Fractals* provides a new model for diversity as a creative force for emergence, a new thinking where we can be diverse and entire at the same time, part and whole, at the heart and the edge, balancing tradition and change, a new model for understanding and a tool for change.

At a deeper, spiritual, global and cosmic level, we are all fractals of the universe, different and similar, on a similar but different journey, as Chopra puts it, “we are travelers on a cosmic journey, swirling and dancing in the whirlpools of infinity.”

## Tsunami, diversity and better model

The world is diverse and complex, especially the areas touched by the tsunami - South Asia and South East Asia, and considerations of fractals may be useful in dealing with the effects of the tsunami.

“It is impossible to exaggerate Indonesia’s diversity,” according to the Economist of Dec 11-17, 2005 in a special article on Indonesia (before the tsunami), which was hit the worst by the tsunami. Sri Lanka and India also illustrate tremendous fractal diversity within diversity, in culture, customs, peoples, religion and thinking, as one of the most diverse regions of the world.

The people affected by the tsunami exhibit the richest and widest diversity imaginable. There are self similar patterns with local variations across the region affected, now with a common need. We can use this fractal diversity thinking to guide us in restoring and renewing the region and its diversity.

Our ideas on diversity were shaped by our experience. Practicing medicine in Toronto and at the Scarborough Hospital allowed us to become part of one of the most diverse communities in the world. It happens to be a region representative of the people affected by the tsunami, with one of the largest Sri Lankan, South Asian, and to a lesser extent South East Asian communities outside Asia.

We learnt about the complexities of diversity from experiencing the complex dynamic interactions and their impact on life and health, and found that the current models incompletely represented their reality. We happened by chance upon a better model, which we used *to understand things better and as a tool for change*.

## Fractal Heart and Diversity

Each person or group is unique, everchanging in time and place, with everchanging identity shaped by and shaping the community.

Fractal describes the rich, dynamic, overlapping multilayered, diversity, variety, adaptability and change better than mosaic, kaleidoscope and multiculturalism, and better describes identity and belonging.

We are all fractals of the universe, a fraction or fragment, and a part and the whole at the same time. We also live in a FRACTAL WORLD with fractal geography and geometry.

Fractals make us individual, each different, but with self-similar patterns that describe our belonging and identity with others and groups. On deeper examination or with more information obtained, fractals lead us into deeper and deeper overlapping layers of ourselves, revealing more individuality and more belonging at each level.

We can be unique and infinite without excluding similar infinity and uniqueness of others or other groups, asserting the intrinsic worth of every human being, which should promote mutual respect

We are all, at the same time, diverse and entire, each a fractal of the universe, at different scales of magnification - a fractal of the country, state or province, town or municipality, region, local neighborhood, and various levels of community.

We are also fractals of a wider community across various borders, cultures, customs, religions, variably and ever-changing. We can be what we want to be, in infinite combinations and diversity, always diverse and entire, representing our uniqueness and our belonging, at the same time.

## Identity and Diversity as FRACTAL:

A new model beyond tolerance to empowerment.  
VS Rambihar MD.

*Reprinted from private correspondence on this topic.*

Beverly McLachlin, Chief Justice of Canada, identified “promoting mutual respect and accommodation within the nation state” as one way of addressing difference, in the Fourth LaFontaine-Baldwin Lecture, 2003 (“The civilization of difference” Globe and Mail March 8, 2003). She asserts that this rests on the single proposition of the intrinsic worth of every human being. She felt that the alternative solution of separating people into autonomous states, and I would add, groups, is not tenable. *The new science of chaos and complexity provides **new meanings, models and metaphors for empowerment**, going even beyond promoting mutual respect and accommodation.*

Credibility for this science was achieved in 2003 when the prestigious Japan Prize for Science and Technology was awarded to Mandelbrot and Yorke for their discovery of fractals and chaos as fundamental structures of nature. Complexity is the term more popular since the 1990’s to represent the metaphoric and more widespread use in society of the ideas of chaos science, described only since 1975, but enshrined in the imagery and philosophy of Eastern thinking and earlier civilizations.

Each person or group is unique, everchanging in time and place, with thus an everchanging identity shaped by and shaping the various overlapping larger social and other networks to which they

belong, identify or associate. At every time and place, their degree of belonging can be determined at multiple levels, being themselves, and a part of the whole at the same time. ***A new model and vocabulary is needed*** to describe the nature of this dynamic and everchanging multiplicity of identities and belonging.

Such a model can be both enriching and empowering. The current models of mosaic, kaleidoscope and multiculturalism do not describe the rich, dynamic, overlapping multilayered, diversity, variety, adaptability and change evident in the complex society in which we live. ***Mosaic*** is too fixed and the pieces are individual without representing the whole. ***Kaleidoscope***, although everchanging, is ***too*** fixed in its ***variability*** without the multilayered perspective. ***Multicultural*** categorizes and alludes to multiplicities but does not evoke a sense of the complex dynamics and interactions involved.

The new science of chaos and complexity provides new meanings, models and metaphors that elegantly describe and empower individuals and groups traversing the complex nature and landscape of their interactions.

The term ***FRACTAL*** is a ***much more*** powerful and ***representative*** image for identity and belonging. We are all fractals of the universe, or fractals of places both local and distant at the same time, being a fraction or fragment, and a part and the whole at the same time. We live in a FRACTAL WORLD with fractal geography and geometry, a new kind of dimension beyond the time and space geography and geometry we are accustomed to.

Fractals make us individual, each different, but with self-similar patterns that describe our belonging and identity with others and groups. On deeper examination or with more information obtained, fractals lead us into deeper and deeper overlapping layers of ourselves, revealing more individuality and more belonging at each level. It takes us to infinity, and with the concept of multiple infinities shows us how we can be unique and infinite without excluding similar infinity and uniqueness of others or other groups. This model thus asserts the intrinsic worth of every human being and should promote the mutual respect and accommodation Beverly McLachlin seeks.

James Gleick's description of exploring a fractal at various scales of magnification, much like obtaining more and more information about an individual or group, in his 1987 book "Chaos: Making a New Science" illustrates how easily we can visualize this image of identity and diversity as fractal.

"A voyage through finer and finer scales shows the increasing complexity of the set, with its seahorse tails and island molecules resembling the whole set...with every apparent floating island connected by a filigree web to the rest...any segment when magnified reveals new islands, resembling the main set and yet not quite the same...each new island surrounded by spirals and flame-like projections, which inevitably reveal islands tinier still, always similar, never identical, fulfilling some mandate of infinite variety...in which every new detail was sure to be a universe of its own, diverse and entire."

We are all, at the same time, *diverse and entire*, a fractal of the universe, at different scales of magnification- a fractal of the country, state or province, town or municipality, region, local

neighborhood, and various levels of community. Parallel to this we can also be fractals of a wider community across various borders, cultures, customs, religions, and be so variably and ever-changing. We can be what we want to be, in infinite combinations and diversity, always diverse and entire, representing our uniqueness and our belonging at the same time.

Fractals also represent the patterns of chaos, which is the science of complex adaptive systems like ecosystems, with novel function and relationships, which provide a model for our interactions with each other, individually or in groups. Such systems display nonlinear dynamics with strong and weak interconnections and interdependencies, balancing cooperation and competition at multiple levels, with sensitive dependence or the power of small inputs to change outcomes. It illustrates for us our interconnectedness and interdependence on each other and our environment, and the power of small changes locally and globally to shape our shared future on this fragile planet. This strengthens the assertion of the intrinsic worth of every human being, going beyond promotion of mutual respect and accommodation to empowerment of everyone, ensnared in a web of network connections.

Fractals, chaos and complexity thus provide new meanings, models and metaphors for identity, diversity and our complex dynamic interactions, which should empower each individual or group in our local and global diversity, in this no longer global village we live in, but our fractal world and a land of complexity, or is it our fractal land in a world of complexity.

## Thinking about the individual

The *complexities* of world social, economic and political events challenge us *to become involved*.

A dynamic balance between the simple and the complex would keep us focused on achieving change without feeling frustrated by the enormity of problems. Keeping the individual in mind refocuses our involvement, as illustrated in this oft repeated story.

From the website: <http://mindprod.com/fatalism.html>

The waves washed crabs up onto the beach where they perished in the hot sun. A boy ran along the beach picking up the crabs, tossing them back into the water. A man said, "Why do you bother? There are millions of crabs? You can barely make a dent." The boy replied "It matters to **this** crab!" as he tossed yet another.

*We can be easily tempted to say - it ultimately does not matter. However it does make a difference to someone.*

The problem with fatalism and saying it does not matter is that it encourages everyone to give up, even when a tiny effort could have beneficial effect, e.g. to bring about world peace, end world hunger, or preserve the environment (from above website).

This tiny effort making a big difference is an aspect of the leverage of chaos – sensitive dependence or the Butterfly Effect. Chaos and complexity also free us from a determined world, where we may think things are already set and our intentions do not matter. The efforts of each of us matter. Even if small, or just in thought.

There is no way to peace. Peace is the way.  
Mahatma Gandhi

*Ideas in this section, the use of chaos and complexity in peace, health and development, were presented by Dr V Rambihar at an invited lecture to Massey College Fellows in Journalism at the University of Toronto, and at the Lancet McMaster Peace through Health Conference in 2005.*

*Interest arose after attendance by Sherryn at the Lancet McMaster Peace and Health Initiative in Hamilton, Ontario, a few years earlier, taking this back to her medical school, and with Dr John Howard, other faculty and fellow students at the UWO and elsewhere, seeking to make global health part of the medical school curriculum at the undergrad and graduate level.*

*It includes ideas from a medical school Patient Care Learning essay by Sherryn Rambihar on “War and Peace and Medicine: An Ecosystem Health Approach,” with ecosystem being an expression or manifestation of the science of chaos and complexity.*

*For the imagination age, we should replace swords and plough-shares with fractals, chaos and complexity.*

## PEACE

Using complexity science to achieve and preserve peace and making complexity the science of peace.

There are complex interactions, with multilevel feedback and change observed in the systems and subsystems involved with Peace. Chaos and complexity science should be relevant.

Since science now includes complexity, science in the service of peace, health and human development should include chaos and complexity.

***The challenge is to move beyond understanding these interactions as chaos and complexity, to now find practical ways to use them for peace, health and development.***

# Peace

Peace is difficult to define, like truth, beauty and love, implying an aesthetic and subjectivity, not apparently rigorously or scientifically definable or addressable.

Einstein:

Peace is not merely the absence of war but the presence of justice, of law, of order - in short, of government.

Dictionary.com:

- 1) The absence of war or other hostilities.
- 2) An agreement or a treaty to end hostilities.
- 3) Freedom from quarrels and disagreements; harmonious relations.
- 4) Public security and order; Inner contentment; security.

Google hits: June 2005

Peace - 19, 800

Peacekeeping

3,519,000

Deepak Chopra begins his book *Peace is the Way* by describing war and its opposite, peace. He advocates that each of us become a force for peace through compassion, renouncing its opposites, with small individual efforts leading to a tipping point to global peace.

Peace is thus

*complex:*

Can you think  
of a good  
definition?

Peace is

.....

.....

.....

.....

## Peace without borders

*Peace is an emergent property of sharing and caring for all humanity and its concerns.*

It results from the complex dynamic interactions of its determinants acting at multiple levels with varying influence across time and space. Peace thus has no borders, and is transdisciplinary, requiring a new formulation, beyond inter or multidisciplinary.

It can be framed through multiple perspectives, including spiritual, ethical, philosophic, scientific, and ecosystem, each, and all of which works, but not completely.

A scientific understanding of peace requires recognition that science is changing, from mechanistic, reductionist, and value-free as normal, through modern, post modern, systems and ecosystem to a post-normal new science of complexity, with uncertainty and values inherent. Since peace is often threatened by differences in values and fixed opinions, this new science should prove valuable.

The new science of complexity allows a true transdisciplinary approach to peace without borders, to include all possible frameworks. *With this, peace becomes an emergent, with properties beyond those of its constituents or determinants.*

## Peace as an emergent property

Peace is an emergent property of the complex and dynamic ecosystem, web-like interactions of its determinants. These are the numerous local and distant factors nested within each other, separated in space and time, with multilevel feedback, acting according to the laws of such complex systems, which is chaos and complexity. These factors are fractal, with determinants within determinants, systems within systems, their effects varying nonlinearly according to feedback and context.

There are long lists of such factors, with varying degrees of importance in each situation or conflict (search web), varying also with context. Identifying specific causes is difficult since these factors contribute to varying degrees at different times, with flash points, sensitivities and susceptibilities as nonlinear responses and effects complicating things further - a fractal “web of causation.”

Problems and conditions that threaten peace usually have many everchanging interacting factors or elements feeding back to each other, requiring new models and methods for understanding and for solution.

*Complexity science provides new meanings, models and metaphors for peace that go beyond ecosystem and webs, and beyond descriptions, to **become a tool for change.***

## Peace as complexity

- Fractal and emergent property of complex dynamic interactions of determinants.
- function of social, political, economic and other complex systems, processes, history, behaviour, culture, customs, etc interacting in subtle and overt ways in individuals and groups
- nonlinear feedback with change and adaptation
- people, communities, agencies, cultures, interest groups and individuals compete, cooperate and co-evolve
- nonlinear ecosystem or web-like interactions with “governing dynamics” of chaos and complexity science

## Features of chaos and complexity:

- multiple perspectives and dissipative structure
- inherent uncertainty and surprise
- fractal nature and multilevel interconnectedness
- self-organization and emergence or “order for free”
- sensitive dependence nonlinearly changing outcomes from small differences
- tool for change in a complex world

## Derived features of chaos and complexity

- *fractal* patterns of self similarity with differences
- *strange attractors*: “strange” predictability - outlines set - uncertain details
- *The Butterfly Effect* - a butterfly flapping its wings in Brazil causes a tornado in Texas; amplification and sensitivities.

## Science and Peace

***Peace requires an understanding of both science and the humanities.*** The human and cognitive sciences address perceived differences, disparities, grievances and sensitivities, modulated nonlinearly by circumstances, leading to conflict or cooperation. Thoughts, feeling, caring and concern for each other and for meaning and purpose make peace also spiritual. Through experience, guided by philosophy or religion, we may come to a recognition of our web-like interconnectedness and interdependencies within a shared environment, illustrating this spiritual feeling towards peace.

The science of peace traditionally looks at measurable social, economic, physical and other factors from the lens of classical science. Modern technology adds a new human science of mind, thought, behaviour and even consciousness, which explores the intersection of science and humanities and is useful for peace.

The ***new science of chaos and complexity*** provides an entirely new transdisciplinary thinking on the nature of the complex ecosystem and web-like interactions and networks that determine peace, which includes physical, basic, social and human sciences, at all its different levels, making peace both scientific and spiritual. It ***thus becomes the new science of peace.***

## Science of Peace

Yusuf, Anand and MacQueen propose a medical science approach to peace (BMJ Editorial Dec 19/26, 2001), which led to the McMaster Lancet Peace through Health Initiative (see web), suggesting that

- Healthcare workers can contribute to understanding and eradication of war
- [We] should develop conceptual models about war which overlap with those for chronic diseases
- [We] should think of war as a complex disease process attacking the global “group organism”

Since medical science has changed to include chaos and complexity (search web for Plexus Institute, complexity health for numerous applications), *the science of peace should then become chaos and complexity, and:*

- Healthcare workers can contribute to understanding the complex dynamics of the interacting networks or agents that lead to the emergence of war, and use this knowledge to avert war and to create and maintain peace
- We should develop complexity based conceptual models for war which overlap those for chronic diseases
- We should think of war as a complex disease process, using complexity based models, attacking the global group organism, which behaves in an ecosystem web like chaos and complexity fashion.
- We should explore complexity for novel and creative ways to further peace and reduce war.

## Science for peace

By 2020 the World Health Organization and the World Bank predict that war will be one of the top 10 causes of disability and death. Because of the success of public health in reducing disability and disease, ideas from health were suggested for peace and prevention of war.

Ideas from the science of medicine and health that can be transferred to peace are:

- risk factors and risk reduction
- gathering, and applying evidence to practice
- prevention of disease to prevention of war
- maintaining health to preserving peace
- health promotion to peace promotion

Yusuf et al (BMJ 1998) suggest that we should apply Virchow's words "Medicine is a social science, and politics nothing but medicine on a grand scale" in seeking medicine as a science of peace.

Social science, politics and health, linked in Virchow's day through medicine, are linked today through modern science and medicine. As human and natural sciences involving complex dynamics, they are even more closely linked today through the ecosystem network-like *chaos and complexity, the science for the 21<sup>st</sup> century*.

## Complexity: Science in the service of peace and human development

“Science in the service of peace and human development.”

Lancet Editor, Richard Horton

Lancet McMaster Peace through Health Conf 2005

Lancet Editor, Richard Horton astounded the audience in a riveting address speaking about interactions, context, society, social determinants and community in his lecture on science in the service of peace, health and development. He reinforced the vital importance of the “softer sciences” in solving such world problems, while recognizing the benefits from vaccines, genome projects, etc, results of science as we know it. Chaos and complexity is increasingly becoming the science for these interactions and “softer sciences” and in a “Letter to the Editor,” Lancet, in 2000, this author proposes chaos and complexity as a new science for health for the 21stCentury.

Citing numerous examples and initiatives, Horton mentioned innovative research by Michael Marmot on the social determinants of health and Amartya Sen’s ideas on the importance of health, politics and society on poverty reduction (please see Lancet Editorials 2005 and web for more on these ideas).

Virchow’s words on medicine as a social science, and Horton’s ideas lend support to chaos and complexity as the science for peace, health and development.

## The use of complexity science

This is a new field, with evolving ideas and increasing applications. Please search the web for listings and discussion. Irene Sanders had made a list of the extensive use of chaos and complexity science, from healthcare to international politics.

***<http://www.complexsys.org/pdf/ComplexityScienceSurvey.pdf>***

She says “the new science of complex systems is moving us away from a linear, mechanistic view of the world to one based on nonlinear dynamics, evolutionary development, and systems thinking. It is laying a foundation for a fundamental shift in how we view the world, and with it the need for a shift in how we think about, organize, plan for, and lead 21<sup>st</sup> century organizations.”

Specific sites of interest to healthcare with links include:

Plexus Institute

<http://www.plexusinstitute.com/index.cfm>

The Exeter Complexity Network

<http://www.dcs.ex.ac.uk/research/complexity/>

Being a basic science and a tool for change, chaos and complexity should become ***the science in the service of peace, health and human development.***

# Complexity, Peace and Health

*Personal correspondence 2001.*

*VS Rambihar and S Rambihar to the authors of the Lancet article referenced, **proposing a chaos and complexity perspective for peace, health and peace through health.***

*The catastrophic events of September 11<sup>th</sup> with local and global intended and unintended consequences risk deepening our cynicism about our ability to sustain peace. This presents now an even greater challenge for understanding peace and health, and achieving peace through health, the intention of the Lancet McMaster Challenge in establishing a new discipline (1). Its need is more acute now with new methods of aggression and response and requires newer ideas for responding to the humanitarian concerns of everyone involved and affected. Innovative ideas from the new science of chaos and complexity could restore our confidence in achieving these goals, framed in the context of some residual uncertainty and cynicism.*

*Health, like peace emerges from the complex nonlinear dynamic interactions of individuals, groups and systems in which they are ensnared (2). These systems are complex and adaptive, interacting at multiple levels, variably, changing each other in sometimes uncertain, unpredictable and disproportionate ways with the potential for surprise in outcomes. The interactions involve the mind, genes and the internal and external environment of customs, culture, beliefs, politics, perceptions, social and economic situation, and biology, at all their micro and macroscopic levels, leading to a web of causation with multiple causes of events (2).*

*The current medical and public health models of prevention, treatment and rehabilitation proposed for describing and maintaining peace and health (3), rooted in an older mechanistic and linear science would thus be limited, especially in the settings above. These presume a reductionist, linear analytic approach to their management, organization, strategy, policy development and practice, despite the complex adaptive systems that constitute them.*

*Chaos and complexity science describes the unusual and novel features exhibited by complex adaptive systems (4). These include the importance of multiple perspectives, inherent uncertainty and surprise, interconnectedness, self- organization and emergence or “order for free,” and sensitive dependence where small inputs can dramatically change outcomes. Derived metaphors and ideas, such as fractal patterns of self similarity with differences, strange attractors with “strange” predictability of outlines set, with details uncertain, and The Butterfly Effect - a butterfly flapping its wings in Brazil causing a tornado in Texas, have entered global culture and describe and shape our reality. Chaos and complexity science has consequently developed into a new management, organizational and leadership science and a tool for change, and has been proposed as a new theory for medicine, health and disease (2).*

*The ideas of chaos and complexity science teach us to be cautious in the use of evidence, which changes with time, circumstance and place - thus context (5). Evidence based practice, a concept originating from medicine, now influences health, policy, management and all science. Peace, health and the intersection of peace and health would be better guided by a chaos and complexity-based approach, which uses evidence in context.*

***The new discipline of peace and health should thus explore the novel ideas of chaos and complexity for new meanings, models, metaphors and tools necessary to achieve and sustain peace through health, and to better attend to the needs of all humanity.***

1 MacQueen G, Santa-Barbara J, Neufeld V, Yusuf S, Horton R. Health and peace: time for a new discipline. *Lancet* 2001; 357: 1460-1.

2 Rambihar VS. A New Chaos Based Medicine: the response to evidence (*Chaos 2000: Making a New Medicine*, vol. 2). Toronto, Vashna Publications, 2000.

3 Yusuf S, Anand S, MacQueen G. Can medicine prevent war? *BMJ* 1998; 317: 1669-70.

4 Plsek P, Greenhalgh T. The challenge of complexity in health care. *BMJ* 2001; 323: 625-8.

5 Rambihar VS. Science, evidence, and the use of the word scientific. *Lancet* 2000; 355: 1730.

The letter above did not discuss human development.

S Rihani has proposed the use of complexity science in development, in his book *Complex Systems Theory and Development: Understanding Nonlinear Realities* and in an article available on the web: “Implications for adopting a complexity framework for development.”

<http://www.globalcomplexity.org/rihani2.pdf>

Elsewhere in this book I have discussed chaos and complexity as a science for development and wrote a small chapter “Chaos out of this world...and in this world too” in *Chaos 2000: Making a New Medicine for a New Millennium*, describing the potential for chaos and complexity to solve world problems, including development issues. The complex and nonlinear dynamics involved in human development make chaos and complexity more appropriate than current mechanistic science in shaping such complex issues.

## Complexity and evidence

Scientific inquiry and practice, for peace, health and everything else, including strategy, policy, planning and decision making require an evidence based approach. Limitations however exist, with a current challenge being translating evidence to individuals, other populations and subgroups. Chaos and complexity science shows that such translation could be subject to complex and nonlinear dynamics, requiring an adjustment for context.

It may thus appear that chaos and complexity is at odds with evidence, since it recognizes irregularity, subjectivity and uncertainty as intrinsic and fundamental, rather than exceptions to be explained away or banished.

David Naylor's Viewpoint article – “Grey zones of clinical practice: some limits to evidence-based medicine” in the Lancet, April 1, 1995 resolves this. He says that “the prudent application of evaluative sciences will affirm rather than obviate the need for the art of medicine. Clinical reasoning, with its reliance on experience, analogy, and extrapolation, must be applied to traverse the many grey zones of practice.” He continues “even good evidence can lead to bad practice if applied in an unthinking and unfeeling way.”

Peace, subjective and dependent on feelings, thought and human interactions, is sensitively dependent on the interpretation and perception of evidence. Differing perceptions of observations, strategy, policies, plans, events and decisions can contribute to conflict that threaten peace, health and human development. ***A complexity model for the use of evidence in context may prove useful.***

## A chaos and complexity model for the use of evidence in context.

The perception of the use of evidence is central to human interactions in the context of inevitable competition and shared resources, and thus to peace.

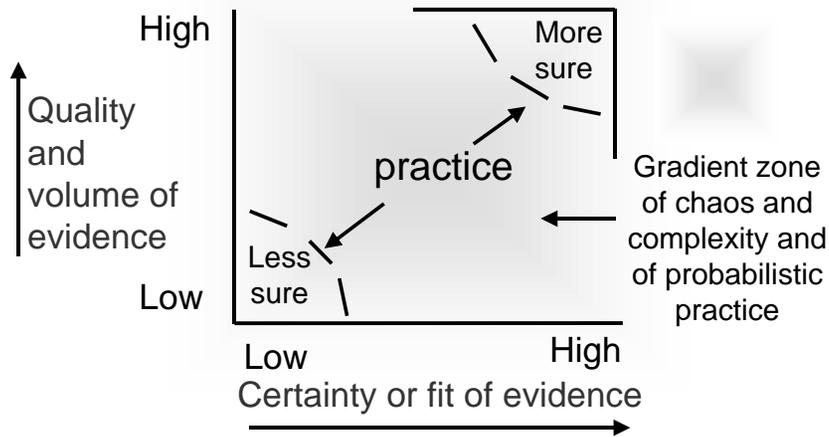


Fig. 1. Modified Stacey Diagram (VS Rambihar)

porous borders and probabilistic practice and chaos & complexity  
 Evidence itself is complex, fractal, changing with time, place and circumstance. Omitted small inputs may change outcomes. The perception and thus utilization of evidence is contextual, depending on many nested factors dynamically intertwined, with fractal shades of certainty.

## EVIDENCE a complexity model

*This model - on the previous page illustrates that:*

- Chaos and complexity resides everywhere, with everything subject to its rules. Although chaos and complexity may impact intensely anywhere on this map, there exists a fractal, probabilistic and dynamic gradient of distribution and thus variation in three dimensions.
- Evidence is mapped on this diagram to guide practice. This introduces order, plan or security in a probabilistic fashion. Agreement or mismatch, with degrees of certainty or uncertainty, exist at opposite ends, and are also intertwined everywhere. In the midst of reasonable certainty, one could still occasionally be completely wrong.
- At any point in the map, by exploring deeper at multiple levels, we could be either right or wrong, depending on context at that level, illustrating the fractal nature of evidence and practice.

**Evidence in the practice of science and peace:**

- The nature of evidence supports a complexity approach
- Translating evidence to individuals, populations or subgroups brings in chaos, complexity, diversity and probability

From *A New Chaos Based Medicine Beyond 2000: a response to evidence*. VS Rambihar. Vashna 2000

## Applications of this model to Peace:

- Consider peace, like health as a function of many interacting agents, systems and subsystems, with multiple feedback loops changing the system nonlinearly.
- Consider evidence as fractal and in context: Multiple levels of truth or fit, which is also dynamic, depending on interactions, scrutiny, time and place.
- Validity of multiple perspectives or diversity of ideas.
- Accept intrinsic nature of unexpected and unpredictable outcomes from interventions. Work with rather than banish such uncertainty.
- Recognize the potential for sudden bifurcations. Tiny events and inputs may amplify at multiple levels, especially at sensitive areas, to destroy plans, or conversely create solutions.
- Recognize the web-like nature of the interactions of constituent systems and agents, with small or large inputs potentially changing the dynamics and sensitivities anywhere in the web, local or distant, amplifying or attenuating inputs and changing outcomes.
- Encourage autonomy and self-organization with few rules to achieve order and power for free.
- Recognize the complex and dynamic nature of the peace process, systems, networks and agents involved.
- Use complex systems ideas from management, leadership, organization, etc, and from other fields, such as politics, economics, social sciences, health etc.
- Fashion and maintain peace from an understanding of the “governing dynamics” of reality, using chaos and complexity as a tool for change.

## Example of chaos and complexity in the service of peace.

Toward a fractal metaphor for liberation of Palestinian Women. Moshe S Landsman  
<http://www.radpsy.yorku.ca/vol2-1/landsman.htm>

The author considers this essay an ecological case study, similar to a clinical tale, and not empirical or theoretical, asking for it to be interpreted through the reader's experience rather by statistics or logic. The ideas arise from talking to Palestinian women about their concerns and struggles. It provides suggestions for activism that may be applied in other complex and dynamic situations. The fractal metaphor was used to understand and to guide proactive processes.

It seems that *patterns are embedded in social activity* as in the rest of the physical world, nested in each other *as in ecosystems*, with the potential for use in facilitating advocacy and intervention for change. While the starting point of intervention may be one of convenience, an effective liberation process requires attention to as many eco-levels as feasible. There is also dynamics, with different strategies needed at different stages, while progression of stages suggest patience in consolidation may be useful before addressing another stage. Parallel phenomena should be looked for in the larger arena and also addressed.

***The fractal metaphor in this situation suggests:*** The level of intervention is not as important as the strategy, since structural and functional changes will eventually interact and cause changes on other levels. Strategy should recognize parallel processes above and below the level of intervention, requiring attention. Changes at one level are portentous of the other, and yields information about the other, suggesting solutions if obstruction is encountered. Meeting the same fractal terrain in advocacy may suggest results are not yet achieved.

The conclusion is that fractals and chaos may provide *metaphors* for *understanding* and *applying* advocacy and *intervention* in the liberation process – as *applied chaos and complexity*.

## Complexity and peacekeeping.

<http://www.un.org/Depts/dpko/dpko/faq/q1.htm>

*Peacekeeping is a way to help countries torn by conflict create conditions for sustainable peace. UN peacekeepers—soldiers and military officers, civilian police officers and civilian personnel from many countries—monitor and observe peace processes that emerge in post-conflict situations and assist ex-combatants to implement the peace agreements they have signed. Such assistance comes in many forms, including confidence-building measures, power-sharing arrangements, electoral support, strengthening the rule of law, and economic and social development. The Charter of the United Nations gives the UN Security Council the power and responsibility to take collective action to maintain international peace and security. **From UN website***

***Complexities thus abound*** in the UN peacekeeping. There are complex dynamic interactions at multiple levels between various agents and networks, feeding back and changing outcomes in an uncertain way. They are subject to sensitivities, nonlinearities and all the other features of chaos and complexity.

The ***increasing challenges*** faced by UN peacekeeping described below also illustrate such complexities, requiring an approach from complexity sciences. Each issue is fractal and complex.

*Where inadequate political structures fail to provide for the orderly transfer of power, where dissatisfied and vulnerable populations are manipulated and when competition for scarce resources intensifies the anger and frustration among people trapped in poverty, armed conflict will continue to flare. These elements provide fuel for violence within or between States, and countless numbers of weapons, readily available worldwide, provide the means. **From UN website***

***Since peacekeeping is complex, it should benefit from the use of chaos and complexity science.***

## Peace through complexity

Negotiating, creating and ensuring peace requires understanding the nature of the complex dynamic networks and interactions towards and away from peace, and the use of new tools to shape outcomes. This is necessary in the reality of a complex world with values, uncertainties, sensitivities, and nonlinear responses.

Anticipating such possible outcomes of interventions and interactions prepare us to make better choices, changing as we gather feedback, our efforts being one contribution to the web-like global peace initiative.

Peace can be seen as more than the absence of war, as a deep feeling of caring and sharing with all of humanity, requiring a complexity science approach to creating and ensuring peace.

We should empower people the world over with a complexity science approach, fashioning peace at multiple and fractal levels, from individual to the various communities within communities, sharing the principles of complexity, of the validity of multiple perspectives and recognizing sensitivities and nonlinearities.

*Einstein said “We can not solve problems by using the same kind of thinking we used when we created them.”*

We need a new thinking for peace. Chaos and complexity science should offer this. A hundred years after Einstein, Hawking says that this century is the century of complexity. ***Let us use chaos and complexity for peace.*** Sustaining the global heart arising after the tsunami is one way of doing so.

## The challenge for peace health and complexity

The Lancet McMaster challenge is to use ideas from health to achieve and sustain peace and from science to improve peace, health and human development.

Science is undergoing tremendous change, reflecting and leading to a new thinking of how we perceive and change the world.

The new science of chaos and complexity complements science as we know it, and can describe the complexities of reality better than this normal science.

Medicine and health, an expression of art and science, reflects and includes the change in science to include chaos and complexity.

The challenge thus becomes - to use chaos and complexity science, new ideas from science, medicine and health – in the service of peace, health and human development, which it is especially suited to do.

The new transdisciplinary science of chaos and complexity should become the science of the new transdisciplinary discipline at the intersection of peace, health, science and human development.

*“The only thing incomprehensible about the universe is that it is  
comprehensible”*  
Albert Einstein.

*“I think the next century will be the century of complexity”*  
Stephen Hawking  
about the 21<sup>st</sup> century.

*“The simple is the seal of the true. And beauty is the splendor of  
truth.”*  
S Chandrasekhar. Nobel Lecture, 1983.

CHAOS  
from Cos to Cosmos  
*really big ideas*

# The Big Bang, origins and everything else

Nothing is as big, or was as small as the Big Bang, a term coined by the eminent astronomer Fred Hoyle, somewhat sarcastically, to refer to the description of the origin of the universe favored by Stephen Hawking, Lucasian Professor of Physics at Cambridge University, and one of the foremost theoretical physicists of all time. Having published papers on singularities in the 1960's, Hawking felt that there was a beginning to space and time, a big bang that would eventually end in a singularity.

Simon Singh, author of *The Big Bang* says in his web site:

*But the theory was controversial. The scientific establishment believed in an eternal universe, and many cosmologists were reluctant to accept a theory that smacked of divine creation. Hence, Fred Hoyle proposed an alternative Steady State model in which the universe was both expanding and eternal. However, even though Hoyle was an opponent of the Big Bang theory, it was he who christened the theory, referring to it disdainfully in a radio broadcast as "this 'Big Bang' idea". The name stuck, and so did Hoyle's opposition to the theory.*

Stephen Hawking also says that he thinks that this century will be the century of complexity. He has been wrong before. But not often. He did say that his idea that no light escapes black holes has some holes in it, making the Big Bang theory not as secure as thought, and Fred Hoyle, in retrospect right. Far be it for any of us to decide if Stephen Hawking is right or wrong. Regarding complexity, it would be unlikely that he would be wrong twice.

In Greek mythology, Chaos is a gap from which everything arose. In theoretical physics, it could well describe other origins, of life the universe and everything else.

## Western science and Eastern thinking

We are blessed with the ability to think and to reflect, to ask questions and to seek meaning and understanding. There are big questions and big ideas concerning life, the universe and our place in it. Both religion and science have sought such understanding. Science based thinking, now dominant in the West, likely emerged from Hippocratic times, when a barefoot, sandaled philosopher physician walking the shores of the tiny island of Cos in Greece around 450 BC sought direct observations of illness, and natural rather than supernatural explanations.

Western society has generally taken its models and metaphors from the scientific ideas of its time. These have gone through tremendous change, with a Newtonian reductionist machine model of how things happen guiding our thinking for the past three centuries. Theories for uncertainty and relativity appeared in science in the early 20<sup>th</sup> century and chaos and complexity by the end of that century.

***The big idea for the 21<sup>st</sup> century is now chaos and complexity science***, which started as an esoteric math and physics around 1975, with similar ideas spontaneously emerging within and between many disciplines in science and society from trial and error of what works. Such ideas, independent of but derivable from the math and physics of chaos have become second nature now since they seem to work. One does not have to know the fundamentals or the details of the math and physics to know or to use chaos and complexity.

Chaos and complexity science ideas are very similar to Eastern thinking, enshrined in their philosophies and religions.

# Life, the universe and everything else: all chaos and complexity

The universe came into existence 13.7 billion years ago. Life appeared in the sea 3.5 billion years ago. Humans appeared only 2 million years ago. Not long ago in this time scale, about 65 million years ago, the dinosaurs died and allowed a mammalian ancestor to emerge as the lineage that eventually became homo erectus and then homo sapiens, the thinking individuals we are today. The power of human intelligence now allows us to contemplate and try to understand our place in the cosmos.

At all levels of space and time in the history of the universe, from quarks, atoms and biomolecules to galaxies and quasars, there exists an organizing principle at work, following simple rules, only recently recognized as chaos and complexity. The universe seems to work through *self organization and emergence* or “*order for free*,” likely what spiritualists and ancient philosophies consider the unseen intelligence of the cosmos.

Diana Lee describes this in her article on the web, “Our Universe – a complex adaptive system.” She considers complex adaptive systems the best model for the real expanding universe. She says, “The universe contains interacting independent nonlinear systems that simultaneously evolve and adapt to their changing environments while maintaining stable global patterns.”

She describes the unfolding history of the cosmos, claiming that all constituents in the universe from the birth of stars to black holes,

quarks to molecules, and single celled organisms to humans have been driven by one [complex] dynamic process - evolution, whose essence is adaptation with novelty, individuality and complexity. She further describes the evidence for such evolution of the cosmos, with the progressive development of galaxies, galactic collisions and birth and death of galaxies.

She further describes bifurcations instigating adaptive change in cosmic as well as biological systems with their numerous subsystems interacting generating patterns, structures and emergent properties from the collective behaviour of the dynamics.

She says that by learning about the past, we can reach an understanding of the cosmos and of ourselves, and perhaps advance humanity for a better future, and that as the universe expands and undergoes constant change, the evolution will be continuous, unpredictable, and more complex.

***The same complex dynamic processes within and between complex adaptive systems that she describes permeate the physical universe as well as the organization of society, peace, health and our humanity.*** The same rules apply with continuous evolution, birth and death of constituent parts, emergent phenomena and inherent uncertainty and unpredictability. Just as creativity was the vital source that sparked life, the same applies to our social and organizational systems, requiring imagination and creativity to spark change.

In Diana Lee's conclusion she advocates that, "to comprehend the human role in evolution, we need to vigorously pursue science to unlock the secrets of the universe." With chaos and complexity science, we may have found the secrets of the universe.

## Secrets of the Universe

Deepak Chopra's "The Book of Secrets" opens with the thought that the *greatest hunger in life* is not food, money, success, etc., but a secret that is revealed only when a person is willing to unlock a hidden part of the self: like a quest far beyond shallow waters in search of the most precious pearl in existence.

This pearl, *the secret of the universe*, Chopra describes as essence, the breath of God, the water of life, holy nectar or in the new scientific age – *transformation*, like a butterfly emerging.

Chopra says that the secret hunger that gnaws at people's souls has nothing to do with externals like money, status, and security, It's the inner person who craves meaning in life, the end of suffering, and answers to the riddles of love, death, God, the soul, good and evil. He says that finding the hidden dimension in yourself is the only way to fulfill this deepest hunger.

This hunger is *heart*, as seen in the global outpouring of support after the tsunami: tsunami heart and global heart. Chopra has something to say about this, even before the tsunami. In his 2005 book, *Peace is the Way*, he says "In thousands and thousands of hearts around the world, compassion is doing its work."

Transformation is the emergence of something new, such as the global heart emerging after the tsunami, changing the world and making it a better place. The *most precious pearl in existence* is thus *chaos and complexity*, the science of emergence. It gives us the power within of transformation to make a difference for all time. It is at the heart of the universe. Chopra's secret lies within us. It also is heart, and deeply spiritual.

Actress Angelina Jolie who starred in Tomb Raider, filmed in Angkor Wat in Cambodia, and goodwill ambassador to the United Nation's refugee agency UNHCR for over four years says "Just being an actress does not help me to sleep well at night. When I do something for other people, then I feel my life has value." She has everything, fame, success, money and was named the sexiest woman alive, and one of the world's most beautiful women, yet she hungered for something more, *heart and global heart*. She has drawn public attention to humanitarian crises in Darfur, Chad, Sudan and Sierra Leone, even before the tsunami. Speaking even then, she had said we should be in this for the long haul.

Chaos science, born of mathematics in Li and Yorke's 1975 paper "Period three implies chaos" and of the physics behind Yoshisuke Ueda's cracked shell appearance of his engineering graphs, Lorenz' computer simulations of weather patterns and Mandelbrot's fractal patterns, is also deeply spiritual and powerful - the heart of everything. Also born of mythology and philosophy as the gap from which everything arose, chaos remains at the heart of everything.

Chaos now moves to the edge, the fractal edge of the universe and the fractal edge where we live, transforming us all minute by minute, changing everything and creating the future of the world. Chaos becomes one of the secrets of the universe, from the heart to the fractal edge of everything. It may satisfy our greatest hunger and make us sleep better at nights.

## Chaos science: sacred and spiritual.

Chopra also mentions in *The Book of Secrets* the age-old choice of separation or unity and says that we have to look with new eyes at the mystery of existence, concerned that as proud children of science, we have made ourselves orphans of wisdom.

The new eyes are chaos and complexity, the new science that transforms the way we see the world. It removes the need for choice between separation and unity, with fractals illustrating the intertwining of unity in diversity, being at the same time diverse and entire, a part and the whole. We are no longer orphans of science but purveyors of the wisdom through chaos and complexity. Although a very new science, it has the same ideas as expressed in Knudtson and Suzuki's book *the Wisdom of the Elders*, secrets gleaned from living in the world.

Stuart Kauffman in his book *At Home in the Universe: the search for laws of self-organization and complexity* writes of a meeting with Scott Momaday, a Pulitzer winning Native American author, seeking to identify the fundamental issues facing humanity. Momaday says "We must reinvent the sacred in the modern world." Kauffmann responds, "I hold the hope that what some are calling the new sciences of complexity may help us find a new place in the universe, that through this new science, we may recover our sense of worth, our sense of the sacred."

Chaos and complexity science is now also sacred and spiritual.

## The secret chaos of the universe.

What can be more spiritual than having a sense for how the world works, the *governing dynamics*, to use a phrase from the film *A Beautiful Mind* where economics Nobel Prize Laureate John Nash is portrayed seeking to answer the question – how do things work.

From the inner workings of every cell to the organization and the birth and death of galaxies, there is an order within the chaos. From the wanderings of a quark, the smallest particle identified to the pulsing of quasars in the far reaches of the universe, there is an unseen intelligence of order and chaos intertwined. Even in our day to day life, our meanderings around our neighborhood to walking to the opposite ends of the planet, from the worlds within to everything we see outside, chaos and complexity is at work.

Things happen according to this chaos, sometimes predictable, sometimes not. Sometimes desirable, sometimes not. Sometimes catastrophic as the tsunami and sometimes slow chronic disasters cycling like the birth and death of galaxies or elementary particles. The same principles that govern those cosmic and subatomic events govern human affairs.

There is an unseen chaos driving everything, enveloping us, seemingly passively swept in its current. It may seem inevitable and all determined, whether you like it or not, as Shakespeare said “All the world’s a stage and all the men and women merely players.” Chaos and complexity says otherwise, that there is an active role for us, where our actions make a difference.

## Chaos, free will and determinism

Is the world determined? Are we merely following a previously written script. Or do we have a say in our future. Stephen Hawking, when asked “Is the universe determined” responds “Yes, but we do not know what is determined.” This however was before Hawking knew about chaos and complexity. Now that he thinks that the 21<sup>st</sup> century will be the century of complexity, he would answer differently “No, but we do not know what is not determined.” This would leave us with a somewhat open universe, one in which we have some control and choice, but one with some determinism and limits.

This is an age-old debate central to all philosophy, science and religion. There seems to be a need for choice between a determined or free universe. A supreme being who knows everything and controls everything, knows all outcomes and paths towards outcomes seem at odds with offering us free will and choice. Science says that things work according to prescribed laws, everything depending on what comes before. There are causes of outcomes, predictors of the future. There is room for randomness, but the only true randomness in the universe is at the quantum level and human scale randomness has to be presumed to be translated somehow from the quantum level.

These are two opposite and irreconcilable views by current thinking. Chaos and complexity changes all that, allowing both determinism and choice within bounds, with randomness thrown in for good measure.

The mathematics of complex dynamic systems or the complex adaptive systems that exist at multiple levels throughout the

universe, in social, biological and physical systems allow “strange predictability.” Bifurcations, sensitive dependence and emergence lead to surprise and novelty as inherent features of the math of such systems. These occur at multiple nested levels within and across systems, enhancing complexity and the potential for choice. Causation becomes complex, with everything, however distant, possibly having some impact on the outcome, which then changes everything again.

Chaos and complexity works in our brains at all levels, from the quantum chaos soliton-like coherence and emergence of thought to the self organization of the complex interacting biological and molecular systems within, that emerge as reason. Within this chaos is the opportunity for creativity and novelty, which essentially is choice, chance and change.

With chaos and complexity we no longer have to choose between free will, determinism and randomness. We have limits to what is achievable which we can test, trying to go beyond boundaries. But within those limits, cause and effect changes to allow leverage, choice and change. We are not doomed to the inevitability of determinism and randomness, but hold the lever for change, the power to make a difference by choice and free will and to change our future, within the limits of the possible. This is also entirely consistent with traditional science and with religion, with determinism of outlines but details uncertain, and open to choice and change.

In the world we live in, we can therefore make a difference. We cannot stop a tsunami. There are acts of God and chaos which are outside our limits. But we can design systems to reduce the consequences, such as effective early warning systems,

infrastructure and social systems designed to increase resilience, and as Professor Stein says in her tsunami discussion at the University of Toronto, thinking outside the box for innovative ideas which can be used before, during and after the tsunami. Or Bruce Mau and Jennifer Leonard's *Massive Change*, designing a better world.

Rather than consider the chronic disasters around the world as inevitable, we could examine the boundaries and not only try to go beyond them, but change the details within. Chaos and complexity shows the power of leverage in such complex dynamic systems and novel approaches for change. Traditional hierarchical methods may not work well enough, requiring the addition of innovation, imagination and creativity.

Society draws its models from the thinking of the time. We no longer can sit back and claim that things are inevitable and unchangeable because they are determined either by a supreme being or by science. The new science tells us that we have a say in the universe, that we can change things and we can make a difference. We will still be subject to randomness, but can anticipate and reduce its consequences.

Science, philosophy and religious thinking can be transformed by this new thinking. A well known theologian author once said to me that what helped him through his heart attack was God and chaos.

***Interesting aside on free will:*** Two Princeton mathematicians, John Conway and Simon Kochen claim they have come up with a theorem that proves elementary particles have "free will" (Siobhan Roberts, *Globe and Mail*, March 19, 2005). Others say they have only proved indeterminism, which is not translatable to the human property of free will. They claim that maybe our free will reflects the free will in the particles in our brains. Probably just willful free thinking.

## Transformed by chaos and complexity.

It seems that chaos and complexity has enough novel ideas to transform the world. We derive our models and imagery of the world from the science and thinking of the time. We have moved from a clockwork universe to a ecosystem type web of interconnections with new ideas on causation, choice and change.

Planning for peace, development, disaster management, health, a healthy environment and eradication of famine, hunger, war, poverty, homelessness, etc all depend on a scientific approach. Policy and strategy, rooted in an earlier scientific thinking, which do not reflect the reality of the ecosystem complex dynamic world we inhabit are changing. Evidence for change and practice should be used in the context of the complex dynamics involved.

The world is being transformed by chaos and complexity. This should be the new science for making a better world. It is already happening. Without calling it by name, the concepts inherent to chaos and complexity are being introduced into the thinking behind change. These have emerged spontaneously as better solutions from experience and practice without starting from knowledge of chaos. More widespread understanding of this new science may make such changes even better and more widespread.

This author has suggested a new probabilistic conceptual chaos and complexity model for the use of evidence, which would reflect the reality of how things happen and change better. A team at the Scarborough Hospital has had a decade and a half experience in community health promotion using chaos and complexity ideas

and have reported its use in medicine, health and nursing in various publications and conferences. We see this as the future, whereby decision making, leadership, management, strategy and everything required for change would be transformed by chaos and complexity.

We feel that this is another secret of the world, one that we found after exploring uncharted seas and after endless journeys, realizing a new understanding of how the world works, and a new way for each one of us to make a difference.

It is rooted in science, has heart and is deeply spiritual. It brings together art, science and humanity in one new thinking, from the heart to the edge of everything.

The new eyes of fractals, chaos and complexity reveal new secrets that make heart and humanity concerns of science, and wisdom deeply rooted in art, science and humanity of the new thinking on chaos and heart. It provides new meanings models and metaphors for transformation, such as fractals with interconnectedness of everything and the Butterfly Effect, the essence of transformation.

The same new science is emerging spontaneously everywhere, transforming thinking in diverse disciplines, with new ideas on how the world started, how things interact and how new things emerge.

## Emergence and transformation

This book is part of that emergence and transformation of new ideas. It suggests encouraging the continued development of a global heart beyond the tsunami, by novel methods. Rather than having a traditional organization with structure, it is open and participative with ownership of the idea by everyone. The thought is planted much like idea viruses, which should spread according to need. It is allowed to self organize with fractal patterns of interest branching off in new directions to respond to needs that emerge.

It will succeed or fail according to the global need, nudged into existence world wide, with this being just one source. The web would be used to bring people and ideas together globally and is perfect to allow the fractal branching for information gathering or sharing in sub-communities instead of sub committees.

This has been done before by this author and many others, and seems to be a new way for change that works. The heart health community project in Toronto started in 1990 was designed with such features of chaos and complexity in mind. It included recently a 2 minute heart project proposed to encourage discussion of heart health information for two minutes at social events.

What's novel is the new method to change the thinking that social functions exist to have fun and splurge rather than practice healthful ways, which would have its own time and place elsewhere. Responding to significant diabetes, heart and blood vessel disease in the South Asian community, we have been able to start change where social, cultural and religious events have included 2 minute health awareness messages. The idea Make May South Asian Heart Month has also been planted to focus attention and raise awareness in this community. Rather than control these initiatives, we have provided resources and information, allowing the community to respond to needs in their own ways, waiting for self organization towards a Tipping Point where such thinking becomes entrenched.

Similarly with this book, encouraging the sustaining of global heart and interest in chaos and complexity.

Deepak Chopra has proposed something similar in his book *Peace is the Way*. Through the book, websites and I am sure other media, he invites the individual to engage in transformation as the way to peace. This would spread from the individual to small cells of interest, ever wider to encompass the world. This is an alternative chaos type of organization, seeking transformation beyond boundaries. Its methods are similar to the ideas of chaos and complexity.

Where Chopra talks of peace, this book talks of heart – global heart. Both aim for transformation by novel methods, Chopra’s originating from spirituality but including science, and this book, starting from science and ending up with spirituality. He says that the real work for peace is proceeding one person at a time and eventually tipping the balance in the world. Similarly with heart.

He says further that, “In every spiritual tradition, it is believed that peace must exist in one’s heart before it can exist in the outer world.” This book invites the reader to transformation to heart, tsunami heart, global heart and peace. It should work, because it is the way of the world.

Chopra says that when Mahatma Gandhi says that peace is the way, he meant that peace has its own power, its own scheme for organizing events and that if you go deep enough into peace, you find power. Sounds like self-organization from chaos and complexity to me.

This allows us to “think global – act local” at the same time as “think local – act global.” Thoughts and actions transcend time and space, gathering a momentum of their own, creating change and making a better world.

## The Power of chaos and complexity:

“A million tiny earthquakes move more ground than a single cataclysmic quake. There is no better or easier way to live than by catching the wave of evolution.” D Chopra in *Peace is the Way*.

The single cataclysmic South Asia earthquake on December 26, 2005 moved a lot of ground and caused a lot of trouble. It however spawned a million tiny quakes of support worldwide that caught a wave of evolution, self-organizing into tsunami heart and global heart as a textbook description of a chaos and complexity way.

From the whispers at the edges of the universe to quarks in the deep recesses of our cells, from the day to day decisions we make to dealing with big problems locally and globally, including catastrophes like tsunamis or ongoing world problems, we are bathed by chaos and complexity.

As the new science of everything, chaos and complexity is now the new science of heart, humanity, peace and it seems spirituality, a new secret of the world. Or so we think, at least for now.

Gerhard Stagnon's book *God's Laughter, Man and his Cosmos* ends with laughter. He explains why, saying, “I have a dark feeling, though, that a humorous quantum of action is hidden in nature that refuses to be mathematically defined. It guarantees that behind every secret that man regards as the ultimate one, another ultimate secret will appear, each time accompanied by an engaging, not at all scornful laughter. But it will only be audible to those with truly ‘spiritual ears.’”

Our hunger is heart,  
tsunami heart, global heart  
and just plain heart.

The secret  
on how to achieve it  
is chaos and complexity,  
scientific  
and also deeply spiritual,  
where we understand  
our place in the cosmos,  
and perhaps meaning and purpose.

*"I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century."*

Heinz Pagels, physicist, 1988.  
Former President NY Academy of Sciences

Ideas emerging from the connections between tsunami chaos and heart  
in 2005 invite a new beginning for theoretical physics to refocus on a  
new way of addressing large world problems  
VS Rambihar

## The Future

Small world - big plans

## Big plans

### ***Use chaos and complexity***

***to rethink the world and  
to make a better world***

for peace  
development  
health, education  
heart health  
global health  
humanity  
biodiversity  
climate change  
ecosystems  
heart  
global heart

***and everything else***

***and to remember the tsunami  
and keep the global heart beating***

Annual Tsunami Valentine's for global heart  
Add global heart to other year round events  
Start 2 minute heart - *global heart*

We're told that it's a small world out there, that we are closely connected and interdependent. And modern communications and globalization make it even smaller, with images like those of the tsunami brought instantly into our homes and minds, even as events transpire. Yet it seems such a big world out there, with such tremendous diversity and disparity that we can never reach or touch or know it all. The concept of fractals helps us to understand how it can be big and small at the same time, how we can live at the heart and the edge at the same time, with the potential for infinity everytime we grasp for anything.

We have moved from a global village to fractal cities and a fractal world. We belong to the world, sharing many things in common across wide expanses of time and space, yet remain homely, local, with culture customs and concerns we share with people nearby and also scattered across the world in varying fractal patterns. We live in everchanging worlds within worlds, both local and global, at the creative edge or interfaces with others in a similar dance to the future.

We create the future from this edge, with everything we do, levers for change. It's a small world and a big world, and we all live at the edge shaping our shared future. Out of this, *we can carve big plans to make a better world.*

There are **big challenges** facing us, but there are **equally big ideas** and **big plans** that we can explore together. The most important and the central theme of this book is that the global heart emerging from the tsunami should be sustained, with a novel approach to use the new science of chaos and complexity. Our experience with this and our plans for the future are mentioned. You are invited to join us in this, designing and creating your own ideas as well.

It is coincidental that this year has been designated the Year of Physics by the United Nations, in honor of Albert Einstein's most famous papers, published 100 years ago. The 20<sup>th</sup> century was thus the century of relativity and quantum mechanics. Another theoretical physicist, Stephen Hawking says that this century is the century of complexity.

Michel Baranger at the Center of Theoretical Physics at the Massachusetts Institute of Technology considers complexity (which includes chaos) as more like theoretical physics or theoretical anything. The anything is the increasing acceptance of chaos and complexity as the unifying science for the physical, biological, social and human sciences. Whatever we expect of physics and the other sciences in making a better world, we should also expect through chaos and complexity.

Coincidental again is the *World Conference on Physics and Sustainable Development* on October 31 – November 2<sup>nd</sup>, 2005 in Durban, as part of the Year of Physics celebrations, which invites “the international *physics community to come together and formulate a plan for tackling some of the large problems facing the world.*” Although this conference will explore new directions for practical physics, the unprecedented opportunity to use new insights from a new theoretical physics to formulate such a plan should not be lost.

Theoretical physics explains how the world works through physical theories, as distinct from experimental physics of experiment and observations, and mathematical physics, with mathematical rigor more important. Chaos and complexity is highly relevant to physics and specifically to theoretical physics.

A century after Einstein’s theories of how the world works, Stephen Hawking, another theoretical physicist announces that he thinks this is the century of complexity. Complexity is now widely applied across many disciplines to explain and change the world.

*Theoretical physicists and others interested in chaos and complexity should come together in Durban and elsewhere to also formulate a plan for sustainable development and the other large problems we face.*

## Exploration of complexity science and development issues has already begun.

Such ideas were discussed in two small book chapters “Chaos out of this world...and in this world too” in *Chaos From Cos to Cosmos* (VS Rambihar 1996), written after a 1993 “Chaos in medicine and medicine out of this world.” conference in Toronto with Roberta Bondar, a physician astronaut.

A book on the subject has been written in 2002 by Samir Rihani from the Center for Complexity Research at Liverpool University - *Complex Systems Theory and Development Practice: Understanding Non-linear Realities*. His website shows how this thinking emerged from theoretical physics or theoretical physicists:

All good things come to an end and supremacy of the linear paradigm, characterized by utter certainty and predictability, was no exception. Einstein (1879-1955), Bohr (1885-1962), Schrödinger (1887-1961), Heisenberg (1901-1976) and Dirac (1902-1984) played a decisive role in pushing conventional wisdom within the natural sciences beyond the Newtonian limits that enveloped it centuries before. Rihani.

Lord Robert May, a theoretical physicist turned biologist, chaos pioneer and President of The Royal Society is doing just that, using novel ideas from nonlinear dynamics (a field closely related to chaos and complexity) to large world problems such as AIDS, conservation, etc..

***Theoretical physics can once again play a decisive role in pushing conventional wisdom in the natural sciences beyond the Newtonian limits that enveloped it centuries before, by exploring the use of chaos and complexity in development and other world problems.***

There is a history of the *limitations of Newtonian science and physics as a science of society, and a possible future for a new physics of society to make a better world.*

The Publisher's description of the book, *Critical Mass: How one thing leads to another* by Philip Ball, illustrates these limitations and the potential application of a new physics to society, politics and economics. (please search web sites for more on econophysics, etc). From Amazon.com website on this book:

“Are there any "laws of nature" that influence the ways in which humans behave and organize themselves? In the seventeenth century, tired of the civil war ravaging England, Thomas Hobbes decided that he would work out what kind of government was needed for a stable society. His approach was based not on utopian wishful thinking but rather on Galileo's mechanics to construct a theory of government from first principles. His solution is unappealing to today's society, yet *Hobbes* had sparked a new way of thinking about human behavior in *looking for the "scientific" rules of society*. Adam Smith, Immanuel Kant, Auguste Comte, and John Stuart Mill pursued this idea from different political perspectives. Little by little, however, *social and political philosophy abandoned a "scientific" approach.*

*Today, physics is enjoying a revival in the social, political and economic sciences.* Ball shows how much we can understand of human behavior when we cease to try to predict and analyze the behavior of individuals and instead look to the impact of individual decisions-whether in circumstances of cooperation or conflict-can have on our laws, institutions and customs.”

“Critical Mass is the first book to bring these new ideas together and to show how they fit within the broader historical context of a rational search for *better ways to live*” from website on book Critical Mass: how one thing leads to another, by Philip Ball.

The new physics, which includes many of the ideas of chaos and complexity, is now being explored for use in making a better world. As someone who was torn between physics and medicine as a career choice, it is very exciting to be involved in physics again, as a possible science of society, peace and development, searching for “better ways to live” and to make a better world. And this new physics comes without equations and mathematics, which means we can all explore it further.

In his book, Ball describes many examples of physics in society – “what physics has to say about...how people make decisions, cast votes, and form alliances, groups and companies. We shall see physics used to explain some aspects of the behavior of economic markets and to reveal the hidden structure in networks and business contacts. We shall uncover physics of a sort in the politics of conflict and cooperation.”

He is cautious however, saying, “Underlying all of this is a more difficult question: Does physics simply help us to explain and understand, or *can we use it* to anticipate and thereby avoid problems, *to improve our societies, to make a better and safer world?* Or is it merely another dream destined for the graveyard of utopias past?”

There is a *history of physics improving the world*, as described in the webpage for the Durban 2005 Conference, but a *concern over the disparity in benefit*:

The web page says: *Think of the contributions that physics has made to the world economy in areas such as electronics, materials, and computer technology, and to health through x-rays, magnetic resonance imaging and nuclear medicine. These contributions are ongoing and should be celebrated during the World Year of Physics and at this Conference. However, many of these contributions have benefited people in the developed world more than those in the developing world. The World Conference will give the physics community the chance to begin to focus on how we can work with colleagues in the developing world to bring more benefits to their world.*

Another physicist, Heinz Pagels, Former President New York Academy of Sciences, writing as early as 1988 says: “I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century.”

If chaos and complexity becomes as useful as promised, and if Pagels is right, then its current use, mostly confined to the developed countries would increase disparity further. Anthony Gatrell, Institute for Health Research, Lancaster Univ discusses this concern about the geography of complexity (see internet “Complexity theory and the geography of health: a modern and global synthesis”) due out in book form soon.

Gatrell says that “despite assertions of interconnectedness, globalization, and the linking of ‘everything to everything else’ (ideas from Barabasi and others) we have not yet presided over the death of distance.” He suggests that although we express global concerns, we still think locally, with local identities, and although concerned about the impact of far away things, **“the impact is surely more acute in the poorest regions of the world.”**

## Valentine's for Global Heart Event 2005

To help overcome this death of distance, and to explore using ideas from chaos and complexity and from the new physics, we organized a small tsunami heart global heart event in Toronto. It was part of our 22nd Annual Valentine's Heart Health Event at the Scarborough Hospital, linking tsunami, chaos and heart as the emerging global heart following the tsunami. It will become an annual event to remember the tsunami and its emergent global heart of support, sustaining it for other challenges and disasters, and also to continue to promote heart health.

This book, linking these ideas and containing heart health and South Asian heart health information was launched at the combined event. Speaking at the event were Member of Parliament Jim Karygiannis, City Councillor Dr Raymond Cho, Dr Paul Caulford Chief of Family Practice and Community Services and Major Dr Bev Smith, member of the Board and Executive Team.

Medical student Sherryn Rambihar opened the program by singing Sarah McLachlan's World on Fire, which has text in the video of how much life saving can be bought with little money. The heart mantra and sutra were read by Rev Yen Jen Sik, a Buddhist priest, followed by a short slide show by Brigitte Nazareth from Pastoral Care and candles were lit for those lost.

The annual interactive discussion on heart health with info displays and blood pressure measurement followed after a short break.

This is suggested as a model of another way of being involved in tsunami global heart. Fundraising is secondary. The primary objective is *sharing and caring, to sustain the global heart emerging.*

## Keep the global heart beating

**1) *Valentine's for global heart.*** Though not universally celebrated, Valentine's is known the world over for heart. Let us use this and other celebrations year-round to rethink the world and to think global heart. ***If Valentine's is for heart the world over, then it should be for global heart.*** Share with others on these occasions year round the opportunity to make a big difference by the little things you do.

***We can do without the extra candy, calories and cards, etc. and the world can surely use the money saved to save lives.*** Sarah McLachlan's video *World on Fire* shows how.

**2) *2 minute heart - global heart.*** Show sharing and caring by mentioning global heart for just 2 minutes at social and other functions to raise awareness, which will translate later to involvement, similar to our successful 2 minute heart for health initiative.

**3) *Remember the tsunami.*** Link tsunami and heart as at our annual Valentine's Heart Health event, and at other events being planned, such as Asian Heritage Month and South Asian Heritage Month. Use such events to remember the tsunami and the global heart emerging.

## global Heart: a Conceptual Age idea.

Daniel Pink writes about a Conceptual Age in his 2005 book *A Whole New Mind: Moving from the Information Age to the Conceptual Age*, describing a

“seismic-though as yet undetected-shift underway in much of the advanced world. We are moving from an economy and a society built on the logical, linear, computer like capabilities of the Information Age to an economy and a society built on the inventive, empathic, big-picture capabilities of what’s rising in its place, the Conceptual Age.”

He suggests that “high concept” including pattern recognition, creating artistic and emotional beauty, narrative, and combining seemingly unrelated ideas into something new, and “high touch” of empathy, subtlety of human interactions, seeking joy in ourselves and others and purpose and meaning are the aptitudes for this new age. This renders “left brain” logic, analysis and information as necessary but not sufficient, with the synthesis and nonlinear, intuitive and holistic, big picture “right brain” as increasingly important.

Chaos and complexity is the science for the Conceptual Age, being both “high concept” and “high touch” more right than left brain. Ralph Abraham mentioned in his book *Chaos, Gaia Eros* of these three streams of history coming together again around 2000. Jon Kabat-Zinn in his book *Wherever You Go There You Are: Mindfulness meditation in everyday living* brings similar ideas for practical benefit to day to day living.

The concept of globalHeart and the idea to keep the global heart emerging after the tsunami beating, fits right in to the Conceptual Age, using novel right brain type ideas to make a better world, one seismic shift applied to another.

## Global heart and economic development

The global heart emerging after the tsunami is timely for improving heart health in developing countries as a way to economic development. This is a new idea expressed in a 2004 “A Race against time” report from Columbia University’s Earth Institute, suggesting that “heart disease and stroke are far more urgent threats to global health than commonly appreciated.” The report says that while cardiovascular diseases in the west is portrayed as diseases of affluence and older people, in countries like India, South Africa and Brazil, cardiovascular mortality among working age people is one and a half times that of the US. Lacking in these countries, according to the report are lifestyle programs like diet and exercise awareness and antismoking efforts that have reduced death rates in the US.

Jeffery Sachs, Director of the Earth Institute explains that heart disease and stroke are particularly devastating in rapidly developing economies since “they exact a crippling toll on more vulnerable countries, hitting not only individuals and their families, but the economies of nations.”

Sachs claims that “we now need to increase the attention we give to cardiovascular disease in low and middle income countries because of the combined health and economic impact” and the report seeks to integrate cardiovascular disease into the health and development framework.

Global heart emerging after the tsunami can raise awareness of this problem and the potential for economic development from health promotion. Simple preventive strategies used elsewhere may prove very useful in this new approach to making a better world.

The Earth Institute accepts that its report is in broad brush strokes implying the need for a less coarse grained approach in time. The concept of **fractal patterns of health** and disease and the dynamical and complex nature of the interactions and interventions should make a complexity science approach useful to fine tune and reshape our policies and interventions.

There is inhomogeneity and dynamics, which complicate health and disease patterns. Not everyone in the developing countries will acquire the diseases mentioned and not everyone in the developed world will be spared. There are geographical, ethnic and socio-economic determinants of disease, which yield inhomogeneity and the need for targeted health promotion to eliminate or reduce such disparities.

The death rate of heart disease in various subgroups in the West, such as South Asians, Africans, Hispanics and Native Peoples are closer to those of the developing countries than at home, and there are pockets within pockets of better health in the developing countries, a fractal like pattern. Omitting this perspective risks overtreating some subgroups and undertreating others.

Gender differences need also to be factored into the larger picture. For example, even with HIV/AIDS as the leading cause of death in South Africa, CVD ranks third in women's disease burden and sixth among men. The earth Institute report says that "among South Africa's non-communicable diseases, the CVD burden comes to rest more heavily on poor women" and that in South Africa, CVD causes the highest portion of lives lost due to non-communicable diseases for poor women – 46%.

## Global heart health and global women's heart health for developing countries:

We know that heart disease in women is different, and that women's heart health tends to be neglected. What we may not have known is that women's heart health globally has been neglected.

In its six key points summary of its report *A Race for Time*, the Earth Institute lists:

- ***CVD should be on the women's health agenda and it is not.*** CVD now causes four times as many deaths in mothers in most developing countries than do childbirth and HIV/AIDS combined, yet ***no funding agency for*** international aid funds anything to do with ***women's CVD***.
- ***Virtually no international aid goes into CVD control at present.*** International aid agencies should add to their agendas serious efforts to work with developing countries to contain their urgent and heavy threats to global health, national prosperity and family life in the developing world.

We invite you to join us in our new global heart and fractal heart project, which will specifically address these two issues and has started fund raising and raising awareness.

We will also continue to explore the fractal nature of health patterns and seek health promotion for vulnerable subgroups in developed countries, just as susceptible to the concerns raised above. We will also continue to explore using novel ideas such as chaos and complexity science, in achieving these ends.

## Complexity and women's health

*Women's health* now goes far *beyond reproductive health* to *include the complex dynamics of all aspects of health*, function and thinking of women. Dr Eileen Hoffman feels that this should be a model for all the medical sciences, using a complexity science approach (Annals of Internal Medicine 2000). Complexity would thus become a much-needed more feminist type science for medicine and health, with a gentler contextual, interactive, interdisciplinary and multidisciplinary approach.

Hoffman adds that the traditional disciplines are not being replaced, but that women's health is simply expanding the view, referring to Albert Einstein's 1938 thoughts in *The Evolution of Physics*, that "...creating a new theory is not like destroying an old barn and erecting a skyscraper in its place. It is rather like climbing a mountain, gaining new and wider views, discovering unexpected connections between our starting point and its rich environment."

Sherryn, one of the authors of this book is currently seeking to expand this view. She is involved in a project with Dr Hoffman in New York and Drs Potter, Goldberger and Higgins at Harvard Medical School to create a learning module for introducing and applying complexity science to women's health, as well as other women and complexity initiatives.

We have previously used chaos and complexity science as an organizing and management science and a new way of thinking for women's health in a unique Diversity and Health project in Toronto in 1994, presented at Nonlinear Dynamics in Nursing Conferences in Chicago and Toronto, at the First International Conference on Women, Heart Disease and Stroke in Victoria, BC, in 2000, and recorded in a book chapter in *Complexity and Healthcare organization* (Radcliffe Medical Press Oxford 2004). *This idea emerged out of a larger project on chaos and complexity as a model for medicine, nursing, health and everything else.*

## Complexity and education, medical education, health and everything else.

Brenda Zimmerman suggested that embracing complexity will lead to innovation in graduate medical education at a Council for Graduate Medical Education Annual Conference in 2005

[http://www.acgme.org/acWebsite/newsReleases/newsRel\\_03\\_18\\_05.asp](http://www.acgme.org/acWebsite/newsReleases/newsRel_03_18_05.asp). She proposed a ***complex learning process*** as opposed to a complicated one, using metaphors, relationships and paradoxes instead of machine metaphors, formulas and rules. She says that the lesson to be learned is “Are we missing self-organization? Does everything have to be driven by a central teacher.”

Such innovation started in the late 1960’s at the new McMaster University Medical School in Hamilton, Canada, which pioneered exactly such a method of education. This was a chaos and complexity school, even before chaos, described by Li and Yorke in 1975, the year I graduated from this school. Learning was self-directed, emerging out of interactions in small tutorial groups with a facilitator. The web-like complex dynamic interactions of individuals and communities were recognized and feedback and change effected in this context. This new approach has since been used widely elsewhere and profoundly influenced my thinking.

Medical and health education at all levels should include chaos and complexity as a method of teaching, in decision making and clinical judgement and as a method for practice as described in *Chaos 2000: Making a New Medicine for a New Millennium*, reprinted from the 1996 - *Chaos From Cos to Cosmos: a new art, science and philosophy of medicine, health and everything else*, suggesting wider applications and use as a model for change.

## ComplexCity: the new urban health

We are fast moving from a global village to a ComplexCity requiring newer models for health and change. By 2010, for the first time in civilization, more than half the world's population will be living in cities, growing to two thirds of the population in 2030. This poses challenges to physicians and health practitioners that may be addressed by newer models derived from the new science of chaos and complexity.

Chaos and complexity science provides a bridge from the earlier perception of a city as marketplace, theater or machine to its newer description as ecosystem-like or organic, as suggested by Jane Jacobs and others. Sholom Glouberman, philosopher and pioneer in the field of complexity and urban health, defines a city as a complex and interactive network made up of many individual, self organizing elements... a network of relationships and interactions in which the whole is very much more than the sum of the parts.

Glouberman redefines city as the dynamic intertwining of networks, relations and interactions of individuals and populations that make up the dynamic and complex entity called the city. The lives of its inhabitants are inextricably linked, bound in woven networks of shared space, resources, transit, social, cultural, political and other systems and subsystems to create an organic whole.

We use the term *ComplexCity*, to illustrate this new complexity perspective of cities, how they function and how to find solutions for the health of cities, their health systems, and the health of their citizens. It invites us to devise newer and chaos and complexity models and tools for change, described elsewhere in this book.

## Ecosystem health and complexity science

*Ecosystem thinking* stands out among the many models used to understand the complex dynamics of health and has become central to the thinking at the Schulich Medical School in London Ontario. It frames the patient in a web of complex social, political, environmental and economic ecosystems, essentially complex adaptive systems, with complex dynamic interactions. Dr John Howard, former Dean of Undergrad Medical Education at Schulich says that ecosystem health is transdisciplinary in nature, bringing together the natural, social and health sciences, and incorporates ecological, social and economic perspectives with human health.

David Suzuki wrote in the Canadian Medical Association Journal in 2002 that the health of our citizens is inextricably linked to the health of our surrounding ecosystems, in seeking to extend the healthcare debate to include ecosystem health.

We suggested in a response to this article that the new science of chaos and complexity better and more realistically illustrates how ecosystems, and complex systems like health work, and that the derived new meanings, models and metaphors could be used to shape the future of health care and serve as a model for change.

*Chaos and complexity is the science base for ecosystems* and other complex systems and describes individual and population health better. It is the governing dynamics, explaining the nature of the interactions and has lessons for how complex systems function in reality. ***Hence our use of chaos and complexity to understand health, create change and make a better world.***

## Clinical economics and complexity

Jeffery Sachs feels that we should adopt a new method - *clinical economics*, as the new economics of development and to end extreme poverty, underscoring “the similarities between good development economics and good clinical medicine” (Time Magazine March 14, 2005). He feels that current development economics, which has been like 18<sup>th</sup> century medicine, should become more like modern medicine, with its rigor, insight, practicality and complex interactions, and that a functioning healthcare system is important to development economics.

As this book, and other writing over the past two decades suggest, we can go even further, beyond the current thinking in modern medicine and science to include the future thinking of chaos and complexity, reflected in some of Sachs’ writings. Newtonian and reductionist science originating a few centuries ago, has taken medicine and health to the far reaches of biotechnology, highly technological and genetic medicine and healthcare. Modernization in public health has similarly taken us to great success in eradication and better treatment of many diseases worldwide.

*The next frontier of medicine and health, and thus of clinical economics would be the introduction of complexity ideas*, which we now propose. Jeffery Sachs is right in seeking a new model for development economics from clinical medicine, but we should use the newer complexity based clinical medicine. Bruce West, a complexity pioneer has just completed the draft of a book on *Where Medicine Went Wrong, rediscovering the path to complexity*, and this author has written *Chaos and Complexity 2000, Making a New Medicine for a New Millennium*, outlining such ideas. There is now an extensive literature emerging on complexity and medicine and health (please search web).

***Medicine, health, poverty eradication and development economics may well now benefit from the new clinical economics of chaos and complexity.***

## Poverty eradication and complexity.

***Poverty eradication and economic development of poorer countries may benefit from a new complexity thinking.*** Writing by Jeffrey Sachs in his book *The End of Poverty* seems to reflect this, where he recognizes the importance of the complex and dynamic interconnections that contribute to poverty and hence in the approaches to addressing them.

Sachs writes, as reported in Time Magazine March 14, 2005:

- *Sustainable development can be achieved only through an approach that considers everything from geography to infrastructure to family structure.*
- *The failure of the Third World to grow as rapidly as the First World is the result of a complex mix of factors, some geographical, some historical, and some political.*
- *The sources of poverty are multidimensional. So are the solutions. In my view, clean water, productive soils, and a functioning health-care system are just as relevant to development as foreign exchange rates.*

Sachs also describes the “perfect storm” like conditions such as climatic disaster, impoverishment and acute and long-standing diseases that keep many countries poor. Such perfect storms represent emergence, the nonlinear amplification inherent to complex systems. His suggestion that economically dominant societies should not imply superiority of any kind, which may well have been from an accident of timing and geography, also reflects the inherent nonlinearity, chaos and complexity of reality.

Sachs further says that, “The end of poverty will require a global network of cooperation...” ***This is the global heart emerging after the tsunami, and which we now must sustain.***

## Poverty eradication and ecosystems

*The global heart of concern now extends to preserving biodiversity and the health of ecosystems, now linked to poverty eradication and development. The New Scientist **Planet in Peril** section, April 2-8, 2005 announces “**To fix poverty you have to fix the planet**” based on the recent Millennium Ecosystem Assessment Report. It emphasizes the importance of ecosystems to people, their health and well being - “how they feed and water us, clothe us and help us stay warm and dry,” noting that we are destroying our ecosystems at an increasing rate, and states clearly that attention to ecosystem services is needed to achieve global development goals*

Any progress achieved in addressing the goals of poverty and hunger eradication, improved health, and environmental protection is unlikely to be sustained if most of the ecosystem services on which humanity relies continue to be degraded <http://www.millenniumassessment.org/en/index.aspx>

The editorial in this issue says that a clear link is made between healthy ecosystems and healthy humans and that if we destroy our ecosystems, our economies and our quality of life will suffer. Duncan Graham-Rowe writes that “People in developing nations will not be able to escape poverty and hunger because their ecosystems are collapsing around them.” Ecologist Jane Lubchenco cautions against reducing poverty at the expense of ecosystem damage, “If you focus only on reducing poverty in the short term, you’re going to compromise your ability to reduce poverty and hunger in the long term, because that depends on ecosystem services.” An example cited is of those living in dry areas in large parts of India and Africa, who rely on ecosystem services such as fresh water and food production, that are already in bad shape.

Understanding ecosystems and how they work in order to fix them and fix the planet is important to fix poverty.

## Ecosystem health as a *specific policy goal*.

Ecosystem thinking guides the approach to human health and the health of the planet at the UWO Schulich Medical School, where “students are taught to consider not just the health of the patient, but the health of the community, the population, the biosphere and the earth.”

[http://www.lhsc.on.ca/programs/ecosystem\\_health/aboutus.htm](http://www.lhsc.on.ca/programs/ecosystem_health/aboutus.htm).

The Harvard Centre for Health and the Global Environment

<http://www.med.harvard.edu/chge/> seeks to motivate people to protect the global environment to preserve human health.

COHAB 2005 - the First International Conference on Health and Biodiversity, August 2005 aims to...address the issues linking ecosystem health, human health, biological diversity and international development.

There is concern about increasing pressure on ecosystems as the world’s GDP quadruples by 2050 - good for poverty eradication but bad for the environment. Unless we plan ahead and make ecosystem health a policy goal as suggested by the Millennium Ecosystem Assessment Report. According to the report, 60 percent of such ecosystem services - natural products and processes that support life, such as water purification – are being degraded or used unsustainably, and this will adversely influence climate change etc.

The nature and function of ecosystems are now increasingly important in fixing our planet, which is under increasing stress. Robert Watson, MA project leader and Chief Scientist for the World Bank is optimistic saying “The future is in our hands.”

*The global heart emerging after the tsunami should now include biodiversity, ecosystem health and the health of ecosystems to sustain the future, now placed in our hands.*

## Ecosystem heart – global heart

The spontaneous emergence of ecosystem health and health of ecosystems thinking – *ecosystem heart* is essentially a chaos and complexity type of emergence towards global heart. It is not an imposed ideology, but a facilitated emergence of what works.

Environmentalists have failed to spark the public's imagination, according to the Economist, April 23-29, 2005. The Leader article mentions the recognition by environmental groups of being politically adrift and dreadfully out of touch, saying "The environmental movement's foundational concepts, its methods for framing legislative proposals, and its very institutions are outmoded. Today environmentalism is just another special interest."

The Economist says that the elders of the movement suggest that the solution is "to step back from day to day politics and policies and to 'energize' ordinary punters..." since the usual method of "Mandate, regulate, litigate," – the green mantra of old, which explains the world's top-down, command and control approach to environmental policy making is slowly changing.

The new mantra for ecosystem heart and global heart is thus becoming chaos and complexity, which explains the emerging global heart with distributed control.

## Democracy, development and complexity

Roy Madron and John Jopling wonders about applying chaos and complexity science ideas to models of human democracy in the *New Internationalist* September, 2003. They claim “most organizational forms today – from transnational corporations to liberal democracies – are based on top-down command and control systems. But humanity operates far more through self-organization, chaos, interdependence, relationships, complexity and networks.”

They feel that “failure to use systems thinking when developing solutions to the problems caused by, for example, the current model of economic globalization – that is, focussing on the system’s emergent problems rather than its underlying causes – can only lead to ineffective and sometimes gravely damaging actions.” They see problems as embedded in evolving sets of interlocking issues and constraints that are dynamic.

They mention Horst Rittel’s division of problems into *tame* or linear and *wicked* or complex, saying that complex problems like current world problems cannot be addressed by the standard approach of dividing the problem into manageable sub-problems to be dealt with in a logical, linear sequence. These require understanding multiple perspectives with active involvement in a constant cycle of thinking, acting and learning together, with trial and feedback – a soft-systems approach.

***Complex systems problems require an approach that understands the nature of such systems rather than the usual and traditional.***

## New directions for poverty, health and development

Chaos and complexity can provide a novel approach to understand the nature of complex world problems, as complex issues with many interacting components and multilevel feedback, and serve as a model for change.

Nobel Laureate Amartya Sen describes poverty as a *complex, multifaceted* word that requires a clear analysis in all its dimensions. He notes that geographical, biological, and social factors *amplify or reduce the impact* of income on each individual, citing examples of lack of education, access to land, health and longevity, justice, family and community support, credit, voice, access to opportunity, etc, stating that many of these factors are interconnected. He describes *diversity and disparities*, especially for women, and pockets of poverty. This has led him to new definitions of poverty and new thinking on change for vulnerable individuals and populations.

Professor Michael Marmot writes in the Lancet, 2005 that reducing inequalities in health requires attention to the *social determinants of health*, to include relief of poverty, and the broader aim of improving the circumstances in which people live and work. The WHO Commission on the Social Determinants of Health will set out guidelines for governments and policy-makers to achieve this and some governments have already instituted programs.

Debt relief and increasing aid would thus be seen as important steps in the multifaceted approach to solving these world problems and *shaping a better future* for vulnerable people and populations.

## Pause to reflect: How things happen and how we can change the world.

This book started with

*Eight million people die  
each year  
because they are  
too poor to stay alive*

and

*In the time it takes you to read  
this box  
seven children will die  
as a result of extreme poverty  
[www.makepovertyhistory.ca](http://www.makepovertyhistory.ca)*

Some things are simple. Most world problems are both simple and complex - many interacting parts with multilevel feedback, changing the future.

Complex things follow the rules of chaos and complexity science.

If we call it complex, we should frame it in chaos and complexity terms.

We could use chaos and complexity science to understand and make a better world.

The global heart emerging after the tsunami is chaos and complexity at work. Let us continue to use it to make a better world.

## Complexity and shaping the future

How can we make reasonable *decisions in an uncertain world* of complexity to shape a better future? Steven Popper, Robert Lempert and Steven Banks address this in “Shaping the Future” in Scientific American March 28, 2005. They describe “well-understood situations,” where science can reliably predict the implications of alternative policy decisions, and the trade-offs that society must inevitably make. They then contrast this with less well-understood situations, where the *problems are too complex and contingent* for scientists to make definitive predictions. They suggest that in the presence of such uncertainty, the machinery of prediction and decision-making seizes up.

New and better tools using adaptive strategies added to those “fixed in advance” are being developed based on the new complexity understanding of the world. Popper and co-authors feel that such strategies can cut through contentious debates by providing plans of action that all can agree will play out, no matter whose view of the future proves correct, citing examples.

They conclude that science and technology cannot change the future’s fundamental unpredictability, but rather offer an answer to a different question: Which actions today can best usher in a desirable future? Plausible futures where proposed strategies fail can be identified by computer or humans, and avoided.

Popper and co-authors claim that we often have little effect on a predictable near-term future, subject to well-understood forces, and it is where the future is ill-defined, unpredictable and hardest to see, that our actions may have the most profound effects. *New tools are emerging to shape the future in a world of complexity.*

## The future in a world of complexity

We create the future minute by minute by our thoughts and actions, individually and collectively. Much of the big world problems like climate change, poverty, etc. are complex - ill-defined, unpredictable and hard to see, often distant to us in the West. It is here that we have the opportunity to make the biggest difference, where our thoughts and actions will have the most profound effects.

Supporting and sustaining the global heart emerging after the tsunami is our lever to the future. Archimedes said that if he had a lever large enough he could move the world. We have such a lever, in the new science of chaos and complexity. Yogi Berra said that the future is not what it used to be. It never was and never will be. We change it minute by minute in small and also profound ways.

*Global heart* opens the door to changing the world in a new way and chaos and complexity provides the tools to achieve this. While the tsunami and other acute or ongoing disasters remind us of our vulnerability, they also inspire us to opportunities for change. We do what we can, some a little, some more, and self organizing in a complex world will bring our thoughts and actions to a new future.

## Making the future with complexity

We figured early on, before there was any literature on this aspect of the subject to guide us, that chaos and complexity was central to everything and could be used as a powerful tool for change. Colleagues locally and globally provided tremendous support and encouragement of these ideas, sensing that they just felt right. Since 1990 we advanced these ideas through various writings, discussions, lectures and projects, everything converging now to global heart, triggered by the chaos of the tsunami.

Applications to solving world problems are now emerging, with many organizations exploring their use. The Santa Fe Institute is the pioneer in this field and the Plexus Institute has done extensive work over the past five years in bringing complexity science to health and medicine. Most universities now have complexity Institutes or Centers for inter and trans-disciplinary research and practice (please search web sites). Worldwide experience in using complexity is developing, such as the report by Glenn Albrecht and others in a Coronary Heart Disease in Australian Coalfields project (Search web for Complexity and Human Health: the case for a transdisciplinary paradigm) and the publication of our experience with heart disease and community health.

## Complexity emerging:

The following is an introductory listing of resources for the emerging trends in complexity thinking, from where you can start and branch out, with links to others, or you may search the web.

### *The Use of Complexity Science*

a comprehensive listing, report in 2003 by Plexus and the Washington Center for Complexity and Public Policy (Irene Sanders), outlines many organizations using complexity -  
<http://www.complexsys.org/pdf/ComplexityScienceSurvey.pdf>

*Comdig* is a free online digest on complexity

<http://www.comdig.org/>

and also lists webcasts and conferences

such as for 2005

*Science, Society and Complexity*, Liverpool Sept,

*Summer School in Econophysics and Complexity*, Romania,

*Dynamics of socioeconomic systems: a physics perspective*,

Germany,

*On the Verge: Changing Lives, Organizations and Minds.*

*Complexity Science in a Changing World*, Florida.

or reports on biologists, physicists and business meetings, and similar unheard of transdisciplinary interactions.

***The future of chaos and complexity is now.***

**How things change!** We are now at the cusp of a wave, a tsunami of chaos and complexity crashing into the future, washing away some ideas, retaining some, rejuvenating the intellectual landscape. Conferences and discourses are emerging everywhere and complexity ideas now emerge everywhere.

The Plexus Conference Sept 11-13, 2005 by the Center for Cognitive and Brain Sciences at Florida Atlantic University, invites us to the verge “where the physical and social sciences meet, where scholars and practitioners bring ideas, actions and realities together in a place of continuing creativity.” The website announces that this conference “will bring together internationally known experts from the natural and social sciences to share ideas, reflect on current knowledge of complex systems, and explore the pressing human goals most likely to benefit from the combined efforts of thinkers and scholars from diverse disciplines.”

Things have certainly changed. I gave a lecture at the same Center three years ago, on essentially the same topic, bringing together ideas from various disciplines in describing my experience using chaos and complexity science in medicine, health and health promotion, and in creating change in the community. I was barely allowed to start, however, with the mostly Master’s and PhD science student audience insisting that chaos and complexity cannot be taken beyond the basic sciences and mathematics. I resolved then never to lecture again on this topic to basic scientists.

The emergence of this Delray Beach conference shows the sea change in thinking in only a few years, from outright rejection of similar ideas a few years earlier, to “using chaos and complexity to change lives, organizations and minds.” ***We are now on the verge of a new future for change.***

There is now a *convergence of ideas* from many different directions towards making a better world, with chaos and complexity central. Stephen Hawking had it right when he said that he thinks this century will be the century of complexity.

Ecosystem heart, health and thinking and the health of ecosystems are now very important in shaping the future of human health and well being and the planet's health, all locked in a web of complex interactions.

Theoretical physics, art, science and the human sciences now meet with the potential to change the world in new and profound ways.

Chaos and complexity, the basic science of ecosystems and complex systems, is becoming a *useful tool* to create desirable change in an increasingly complex world.

This new science teaches us not only our limitations in the complexities of the real world, but guides us in learning to live with and to make decisions in the midst of uncertainty. It gives us intellectual honesty in facing world problems with transparency and cooperation.

*Chaos and complexity extends our reach to a new global heart, to include concerns of all humanity.*

## Start with the heart... and mind.

MIT psychologist Jon Kabat-Zinn argues eloquently in his 2005 book *Coming to our senses: Healing ourselves and the world through mindfulness*, for mindfulness as a universal meditation to understand, pay attention to and be aware of the world, **and to create change**. *Mindfulness* as used by Kabat-Zinn and as he mentions is described by Nyanaponika Thera is, “the heart of Buddhist meditation.” Mindfulness and global heart are thus the same, a convergence of ideas from a psychologist, more familiar with mind and a cardiologist, more familiar with heart.

Kabat-Zinn uses ideas from chaos and complexity science in seeking change, describing the Butterfly Effect, interconnectedness, self-organization, emergence and much more in explaining how to make a better world, describing “the activity of human beings, or the process of thought itself” as complex, dynamical and non-linear, where “a tiny shift can result in changes of enormous magnitude.”

He starts his book by saying “...*it feels like we are at a critical juncture of life on this planet. It could go any number of ways. ...How we manage to see ourselves and the world at this juncture will make a huge difference in the way things unfold.*”

...and ends it thus “*What is at stake, finally, is none other than our very hearts, our very humanity, our species, and our world... What is required is nothing special, simply that we start paying attention and wake up to things as they are. All else will follow.*”

The tremendous *tsunami like wave of excitement* in the use of *chaos and complexity science* ideas now reaches to medicine, science, health, society and much more.

This book proposes using these ideas for complex world issues such as development, poverty reduction, education, peace, global heart, climate change... and just *heart*. It is a massive change of thinking from just a few decades ago, but 400 years in the making.

Modern science made the genomic and other revolutions possible. The new frontier is complexity, from biocomplexity deep within our cells, through social and human scale complexity, to the far reaches of the universe, from quarks to quasars.

Science as we know it has changed. In the UNESCO website on “Complexity- the scientist as advisor” Director General, Frederico Mayor mentions the inadequacy of knowledge about complex dynamic systems. Theodore Brown discusses the metaphorical nature of science and the creativity in science as in art. The web like nature of nonlinear interactions and interventions that change the future are increasingly considered in complex world problems. Paul Davies in the New Scientist 5 March, 2005 even writes of “Higher laws and the mind-boggling complexity of life,” with computationally intractable complex systems and possible not-immutable new laws emerging from the complexity. But this is another story, far beyond the scope of this book.

Science now explains the complexity of the world and the world of complexity, and provides a new tool to create change and to make a better world. *We are now ready to replace swords and plough-shares with chaos and complexity.*

## Massive Change (see web site)

Bruce Mau, a designer, has turned around the world of design to design a new world.

To solve current world problems, we now require a similar **massive change** in thinking to chaos and complexity science, 400 years in the making, now ready.

We have already seen the massive, tsunami like global wave of support after the disaster, as chaos and complexity and the **global heart emerging**, which we now need to sustain and **reshape the future**.

# Tsunami, chaos and global heart

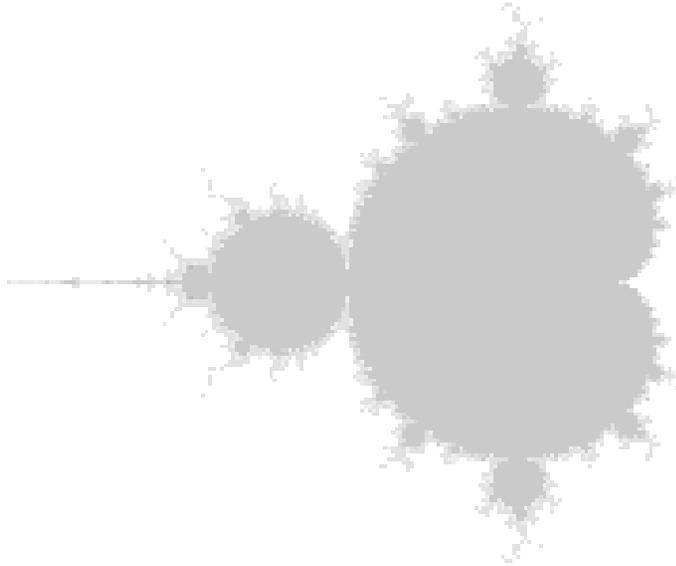
invite us to  
*rethink the world* and our connections,  
to look at  
fractals, chaos and complex dynamics  
for a new understanding of the world and  
for new methods for change.

It is a big world made small -  
a fractal world  
not a global village,  
where we live  
at the heart  
and the edge at the same time,  
riding the wave of  
chaos and complexity  
as it crashes into the future.

This exploration,  
with origins in  
theoretical physics of the last century  
is the dawn of  
a new era for  
heart, health, humanity,  
peace and development,  
and everything else.

*Let us keep the*  
***global heart*** beating  
that emerged  
from the ***chaos*** of the ***tsunami***,  
using imagination and creativity,  
and use the new science of  
***fractals,***  
***chaos***  
and complexity  
to rethink and make a better world

*...so, let's start with heart...*



*...global heart.*

the end of this book as first planned.  
Please read on for ***Tsunami Serendipity***  
and ***Update Dec 2005*** – with even newer ideas.



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Action Plan for change*

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2006: Review: one year after.

We are citizens of the world, we hail from every part of it  
and we're connected to every corner of it.

Dalton McGuinty, Premier of Ontario

*This section recognizes the selflessness and dedication  
of the countless people who helped in innumerable  
ways, both locally and globally,  
with the tsunami and after the tsunami.*

*It recognizes also those whose involvement was caring  
and sharing, and those involved in their own  
outpouring of global heart elsewhere,  
making a better world.*

*While actively supporting all efforts at tsunami  
rehabilitation, we focus broadly on the fractal  
patterns of global challenges, searching for novel  
methods, and finding some useful ones, unexpectedly.*

Three Princes of Serendib were always making discoveries,  
by accident and sagacity,  
of things they were not in quest of.

Michele Tramezzino, 1557, and Horace Walpole 1754

# TSUNAMI SERENDIPITY

## Searching for tsunami finding heart

*Thoughts from Sri Lanka  
six months after the tsunami*

*I have talked to many people who have been involved with the tsunami, some traveling there after, some caught in the tsunami, and many others working for tsunami relief locally. They have all been transformed and many have great ideas we can support. Together, we can make a difference.*

*written by*  
**Vanessa Rambihar**

Undergrad UWO student, while traveling to Sri Lanka with McGill student Michelle Ngai, on a volunteer project and as part of a tsunami global heart initiative.

*Please search*  
<http://edition.cnn.com/SPECIALS/2004/tsunami.disaster/children/>  
*for CNN coverage about the children*

## Sri Lanka serendib: *In search of tsunami, finding heart*

I had the privilege to travel to Sri Lanka for a few weeks in August 2005 to volunteer in a home for destitute children, to help with preparations for admitting children who suffered from the tsunami.

I met a few children whose lives were directly touched by the tsunami. It was serendipitous however. I found much more, both unexpected and useful.

Sri Lanka is the land of Serendipity, and that's how I ended up going there. *Serendipity is finding something unexpected and useful while searching for something else entirely.* The word was coined by Horace Walpole in 1754 from the Persian Fairy tale, *The Three Princes of Serendip*, published by Michele Tramezzino in 1557, with Serendip or Serendib an old Persian name for Sri Lanka. While seeking to volunteer internationally, I unexpectedly found out that my previous high school, Havergal College, was looking for someone to explore volunteer opportunities with the Paynter Home in Sri Lanka, to which it donated funds raised by the students after the tsunami.

***The stories of the children in the home touched me as much as the chaos of the tsunami did.*** They had upheavals in their own lives as devastating as the tsunami. Yet I saw in their eyes the joy of expectation for something better, the hope for comfort, solace and a future. They laughed, played and made mischief just as we do here. They opened their hearts to me and I was changed. I left here seeking tsunami and found ***heart***, the heart of children, aching for a future.

***Global heart is one way to help salve the heartache.***

## Escaping the waves.

When the tsunami struck, one of my high school friends was at Galle Beach in Sri Lanka. What she saw and experienced affected her profoundly and inspired me to become involved.

Images of the tsunami, along with stories of people affected and people and organizations involved in relief efforts, as well as discussion about tsunamis can be found on numerous websites. Just search tsunami or South Asian Tsunami in Google, MSN, Yahoo or other search engine.

One interesting link to this book, with more pages to be added later, is [femmefractal.com](http://www.femmefractal.com) a website on women and complexity.

<http://www.msnbc.msn.com/id/9076807/>  
“How Asian tsunami's waves swept the globe”  
shows how tsunami waves reached as far as  
Canada and Peru.

We cannot escape the waves. My friend did escape the waves off Sri Lanka, but none of us can escape the ripple effect of tsunami waves that follow us everywhere.

## Children's stories: strength and hope

I spent three weeks at The Paynter Home in Nuwara Eliya in Sri Lanka, helping destitute children and learning from them. This home was a safe haven from the challenges and hardships they previously endured. There were about fifteen 5-16 year old children at the home; the others had gone to relatives for summer vacation.

They all marveled and delighted in the little things we too often ignore, like the refreshing splash of a waterfall and the surge of the wind lifting a hand-made kite. They are grateful for all that they have been given and were selfless in their interactions with each other and with me. Each day there I learnt more, especially to appreciate the little gifts we all have been given.

These children opened their hearts to us, happy just to share moments together. Even though we spoke no Sinhala or Tamil and they spoke little or no English, gestures, movements, and intonation were enough.

Smiles were universal, exactly as my first year psychology book said.

Not yet exposed to the complexities of our modern world, theirs was one of natural innocence, hope and trust, responsibility and kindness, like helping without

being asked, or saving a bird caught in the crevice of a roof, rather than the display of material possessions and overconfidence we see in the west.

Smaller in stature than children in Canada, their small shoulders bore greater burdens than the 40 kilogram bags of rice I saw them carry. They carried the weight of their past, as constant reminders plagued their young minds each time they traveled beyond the gates of the home.

They had a maturity born of necessity. While I was home in Toronto debating which movie next to see, which clothes to buy or which shoes to wear, they may have been scouring the streets debating where to sleep and what to eat, before they found the home.

Each of these children now has a changed future. The support and encouragement at the Home has made such a difference to them. We should somehow find it possible to do more, for them and for others elsewhere. These children have warmed our hearts, have shown us their resilience, and given us new perspective.

***The stories and the experience will remain with us and have changed us, that we now see the world with transformed eyes. We now also have a changed future. We know that the stories of strength and hope inspire us all.***

## State of emergency

A state of emergency was declared while I was in Sri Lanka, on August 12, 2005, hours after the Foreign Minister was killed outside his home in Colombo. This was thought related to his tough stance against the Tamil movement for a homeland in the North and East of the island. It raised the possibility of escalating violence, threatening the uneasy peace process under way since a ceasefire was signed in 2001.

I was naturally afraid, since the island has a history of ethnic conflict and violent clashes, mostly between the Buddhist Sinhalese majority (73%) and the Hindu Tamils (13%), with the rest of the population being mostly Muslim and Christian. Such conflict even compromised tsunami relief, with protests about the government administering tsunami aid and relief through Tamil organizations.

Fortunately, there was no escalation, and the state of emergency did not have much impact where I stayed. I was in Nuwara Eliya, in the hill country in the interior, which historically has been spared much of the conflict. Being there at that time, however did show me the *potential politics of tsunami aid and ethnic conflict*.

## No ethnic strife at the home

The Home was a haven of diversity. Unlike many others, with single gender, religion and types of children, the home I was at enjoyed a wide diversity – of boys and girls, Tamils, Sinhalese or Muslim, and children of mixed descent. Despite the ongoing Tamil-Sinhalese unrest across the country, these children live, work, and play happily together, oblivious to ethnic strife.

There was also diversity of age and place. We enjoyed meals with Aunty Val, the 89-year old mixed Sinhala/British widow whose father-in-law founded the Home, and with her Sri Lankan-born, Torontonion daughter. They became our mentors, offering a wealth of knowledge and wisdom, as is expected and welcome in eastern culture. We enjoyed the days with the young, enthusiastic children, who showed us their charm, charisma, care and strength.

United by difficult pasts and a common desire to build a future, these children sing their songs of thanks in Tamil, Sinhala and English. They share in their quest for education, learning all three languages at school. Tamil children attend the Roman Catholic school, while the Sinhala attend the local government-run public school. At home they are all one.

We attended both an Anglican Sunday service in English as well as a Roman Catholic Church Service in alternating Sinhala and Tamil and on one occasion listened to visiting Korean singers.

We were exposed to the beauty of many cultures, some still caught in an interminable clash. The harmony between children of such differing backgrounds in the Home, offers hope that love and friendship can triumph over conflict.

## Birthday wishes: akees to the world.

I arose to screams of “Akee, Akee, wake up!!!” Bright-eyed, smiling faces waited expectantly outside my door. One-by-one I was given the customary birthday handshake from each child, along with personalized, hand-made cards. In the middle of

August, my birthday cards were decorated with pictures of Christmas candles, Santa Claus and images of winter, copied from the only Coloring Book they had. Never mind, it wasn’t Christmas, or never real winter there. They had ingenuity and resourcefulness, using what was available. I was touched.

My birthday was the opportunity to offer the children a *novel* treat.

Simple, pre-wrapped ice cream cones, something we take for granted, was a marvel for them. The youngest child sucking the ice cream from a tiny hole in the packaging meant that an unwrapping demonstration was necessary, followed closely by messy hands, ice-cream smeared faces, and a few cries of,  
 “We wont ever forget *this* ice cream!”

I chose to celebrate my birthday in Sri Lanka, far away from home, with the children at the Paynter Home. I was born in a land of opportunity while the children at the home were born in a land of challenges, leaving them once destitute. Our lives intersected for a few weeks, traversing a few birthdays, before we settle again into our different worlds. Yet they are just like me, full of excitement, eager to share, longing for hope.

I woke up that day as akee, (big sister). I became their akee for a few weeks. It was not long enough. I also woke up that day to the fact that we are akees to the world, not for the day, or for a few weeks, but for life.

## ***Birthdays for a better world.***

Birthdays celebrate life itself and offer time for reflection and action. Leaving the children on my birthday to begin my trip back home was cause for more than reflection. Glistening eyes met mine as tears rolled down cheeks I may not see again. Looking hastily away from watery, bright-red eyes, I searched frantically around the room for something, anything else to distract me.

### ***And then it struck me.***

Every birthday, I will celebrate and reflect, and do even more. Birthdays can be used to make a better world. It is the day we should celebrate receiving the gift of life by helping others to a better life. For many people, the little things we take for granted, are marvels and treasures.

Instead of yet another birthday gift, how about asking for something for the children, or for others for whom a little could make a big difference. Enjoy some; convert some to gifts to the world. Ask instead for some to be made as donations to worthy causes, the world over. Just a little, by a lot of us, and we will make a difference.

Do something creative on your birthday. Plan activities that teach about the world, make gifts where it counts.

***Make birthdays make a better world.***

## Sick in Sri Lanka

I woke up to the sound of knocking on my door, and “Vaness-Akaa...telephone call for you!” Muscles aching after a restless sleep, I stumbled out of bed, clumsily put my shoes on and began to walk towards the door. The room began to spin, which I figured was because it was so early and the need for new spectacles. Only one step further, everything went black and I crumpled to the floor. Distant screams of “Aka no!!” floated through the air as I drifted in and out of consciousness. Within a minute I stood up, dazed, and walked towards the door. I fell again, the room fading to darkness.

I was hauled up onto the sofa, limbs heavy and immobile, everything still blurry. I felt warm, my body burning up, conjuring thoughts of malaria, hepatitis and West Nile fever, things I had read about. Weak and nauseous, I turned around to see the concerned and anxious faces of the matrons and the children I had come to help. I succumbed to the drowsiness and weakness taking over my body and fell asleep.

Unable to eat, and growing weaker by the day...I agreed to be taken next day to hospital in Kandy, hoping to improve by then. I did not want to experience medical care in Sri Lanka first hand. Reading about health care in developing countries in my Health Sciences class in university in Canada was enough. I read that care was uneven, with the best care interspersed with poor access and limited resources, to a scale unimagined in the west.

*I was now scared, forced by personal experience to think about the global disparities in access to and quality of health care.*

## Taken to hospital

We arrived at the Kandy Lakeside Adventist Hospital, after a bumpy three wheeler ride. The hospital was dimly lit and calm; everyone probably at the last evening of the Perehera Elephant Parade across the lake. The doors to each consultation swung open, real western style, to reveal well-worn curtains around the hospital beds. Blood tests were done at the same counter where I handed the requisition.

The staff, nurses and doctors were extremely kind. Waiting anxiously for my results, I curled up on the wooden benches reminiscent of church pews, which lined the waiting area. My gaze drifted to the mélange of colorful fish swimming in the aquarium, and then up to the map of Sri Lanka displayed prominently above. This was a private clinic, as the decor made obvious. I was spared the experience of the public system, which is much different.

The verdict came half-an-hour later as I sat shivering despite the warm, Kandy night air. I had a virus, possibly Dengue. I was dehydrated, with a low platelet count. If anything got worse in 24 hours, I would be admitted and would miss my flight. For the first time in this trip, all I wanted was to be back home.

***2.2 million children die of dehydration each year. About 6,000 each DAY. I did not want to be one of them.***

Search to learn about this and 10 facts about children worldwide.

Oral rehydration therapy (search web) can prevent these deaths.

<http://rehydrate.org/dehydration/index.html>

[http://www.rehydrate.org/facts/ten\\_facts.htm](http://www.rehydrate.org/facts/ten_facts.htm)

## Return home.

I suffered through the next twenty-four hours, boarding the plane looking better, or so I am told. In a few hours we were in Dubai, changing planes. What a contrast. I had spent two days there, before going to Sri Lanka. Everything was available there, including easy access to the best of western health care, the most exclusive shopping and the most recent brand name products.

I thought about the children I left in Sri Lanka and the children I met in Dubai. Only a few hours away, but worlds apart. The children in Dubai frolicked on newly designed playgrounds and water parks. Those in Sri Lanka excitedly played simple games with me on dusty roads and showed me how they spread clothes to dry on the roof of their home. Computer games were everywhere in Dubai. Pencils, writing paper and crayons were treasures for the children I worked with in Sri Lanka. The children in both places were happy, but their lives and futures were so much different.

There are many places in Sri Lanka, and throughout the developing world, where children have much more than these children have, and undoubtedly some places to rival Dubai. But there are many more with less, and with even more limited future. It is such disparities that we observe.

***And this is why we must continue to think global heart, and sustain it.***

## 10 ways to global heart: things we can do.

1. ***Make heart and global heart part of everyday thinking and living.*** Be creative and innovative.
2. ***Birthdays:*** Enjoy your birthdays, birthday gifts and parties. Ask for donation of specific needed things (make list) or to worthy causes, as an option for gifts.
3. ***Valentine's Day:*** Make this a day for Global Heart. Buy less chocolates and cards and send what you save to where it makes a big difference. That's real heart.
4. Make ***global heart-themed events*** around birthdays and other celebrations, to talk, discuss and invite action.
5. ***2 Minute Global Heart:*** Spend 2 minutes at social or other events to talk about heart and global heart.
6. ***Rediscover the world.*** Learn about the exciting diversity of people and ideas from all over the world.
7. ***Listen to people's stories,*** from everywhere. Share these stories, talk and learn from them.
8. ***Make the world yours.*** Be interested and involved.
9. ***Rethink your world*** - your values, motivation. Do things that matter and make a real difference.
10. ***Anything else you can think of.***



# Appendix 1

A mathematical (chaos and complexity) theory of  
medicine, health and disease:  
*refiguring medical thought.*

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**M Baum**, Professor Emeritus of Surgery and Visiting Professor of  
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*Reprinted from:* A New Chaos Based Medicine Beyond 2000:  
the response to evidence.

Ideas presented at “Rethinking Cancer Research: Blue Skying  
the Future,”  
Newton Institute for Mathematical Sciences, Cambridge  
University, Dec 2000

## A mathematical (chaos and complexity) theory of medicine, health and disease: refiguring medical thought. VS Rambihar, M Baum. 2000.

*There is a substantial refiguring of medical thinking (1), which emerges from a changing culture, science and world-view derivable from the non-numerical mathematics of nonlinear dynamics or chaos and complexity theory, developed since 1975 (2-5). Being plausible, descriptive, explanatory and predictive, and widely used across many disciplines intersecting medicine (3-5), it should prove useful in the refiguring of medicine, health and disease.*

Disease models change, from the supernatural of the ancient and medieval through various versions of scientific theories originating mostly after the 17th century (6-8). Earlier theories are discarded, modified or incorporated into larger meta-theories; e.g. the miasma theory of infection has been replaced by the germ theory, now part of the current biological theory of disease.

World-views also change. The Newtonian mechanistic and reductionist scientific world-view, brought to 19<sup>th</sup> century medicine as a new scientific method by Claude Bernard (8), still dominates our ideas on health and disease. The ensuing biological model presumes a linearity to events, with approximations and numerical refiguring to explain discrepancies. Only in the last decade have the novel ideas from the mathematics of nonlinearity - chaos and complexity theory, slowly entered medicine, health and disease (3,5-7,9-12).

These ideas represent a fundamental change in our world-view and provide a previously unavailable scientific model for observed variation and the irregular, uncertain and unpredictable experienced as reality (3). Linearity, a special case of nonlinear dynamics, as the current medical model, presupposes predictable outcomes and summation of parts to equal the whole (9,13). Interaction terms, approximations and statistical manipulations are used to adjust for discrepancies while limitations reflect inadequacies, omissions, bias or randomness (11,13).

Feedback and interrelatedness render medicine, health and disease, complex or nonlinear, with novel features arising from the mathematics. These include

intrinsic unpredictability with outlines set but details uncertain, the emergence of new states beyond ordinary summation, fractal patterns with self similarity at different scales, sensitive dependence with small inputs potentially changing outcomes, and self-organization and emergence arising from interactions (3-5).

This mathematical model refigures the thinking on genes, the genome project, and diseases with a genetic component (3,6,13). Genes interact dynamically with the environment and with each other to express or suppress traits, outcomes, health or disease. The interactions are multilevel, complex, numerous, and feedback into each other. Despite some predictability, such complexity can not be expressed by linear models, and the consequent development of heterogeneity from biological diversity is better described by the mathematics of complex systems. Linear models are limited in explaining complex multifactorial phenotypes, and even apparently simple Mendelian genetics (13). Complexities of genetic expression described by the mathematics of nonlinear dynamics would suggest both caution and optimism for intervention and change.

Coronary artery disease (CAD) emerges from the complex dynamic interactions of genes and the environment producing somewhat unpredictable, unexpected and unexplained events (3,5,14). Plaque rupture, chronic CAD and coronary events result from the nonlinear mathematical summation of the physical, biochemical and other local and distant forces (15). Interactions of risk factors yield multiplicative rather than additive effects. Elevated Lp(a) levels, predominantly genetically determined, amplifies the risk from various single factors 2-9 times, and clustering (an adverse total cholesterol/HDL ratio plus two other factors) doubles the expected additive risk (16). Slight changes in cholesterol levels or in coronary artery diameter yield disproportionate benefits in clinical outcome. Cultural, social, behavioral, economic and other factors with multiple feedback loops interact dynamically with the biological, yielding further nonlinearity and surprise in the progression or prevention of CAD.

Nonlinear dynamics has been used or explored widely in medicine and health (3,5). Chaos models of brain function may yield different treatments for epilepsy, cognitive and behavioral disorders. Improved pacemakers and antiarrhythmic agents result from a chaos model of heart function. Cancer and metastatic spread in the context of gene environment interactions have been explored from a chaos perspective, with the potential for different strategies for treatment and prevention (6). A chaos model for clinical judgement and clinical

decision making (3) and a model of disease as loss of a healthy dynamic equilibrium with the environment (17) have been described.

Numerous other examples of nonlinear dynamics in medicine exist, from cyclic variation in neutrophil count and immune response to the epidemiology of communicable diseases and even a model for consciousness. Health care delivery, organization and strategy for health have also used chaos as a new organizational, management and leadership science, following extensive experience in the social sciences (5). Chaos models are being explored in medicine and health to refine prediction as it has been for weather (18) and financial markets (19) and to improve medical practice (20).

Nonlinear dynamics forces us to rethink our ideas on causation, risk assessment and intervention (3,13). Can one attribute cause to effects when influences are multifactorial, contextual and nonlinear? Interventions could be directed at multiple contributing factors to reduce nonlinear interaction effects, and only slight changes may sometimes be necessary. Lowering cholesterol below a desired threshold should reduce the amplification effect of high Lp(a), a risk factor not easily treated. The prevention, cure or more effective treatment of cancer may reside in multiple smaller inputs at critical points (6). Small, appropriately selected changes, may yield disproportionate social and cultural benefits that impact health, disease, and prevention.

The meaning and use of evidence requires revision with this new refiguring. Evidence is contextual, subjective and has limitations (5,7,21,22). Evidence based practice, although claiming to address the concerns of the individual, has no plausible model to do so. Nonlinear dynamics offers a philosophical and metaphorical bridge to reality and the individual, and supports the use of evidence in context as the best we have, for both populations and individuals (5,13). It encourages the use of other plausible methods of inquiry and understanding, such as personal significance and narrative and qualitative methods, and reinforces our practice of medicine as an art and a science (3,5,21,22).

*Nonlinear effects shape the emergence of health and disease. A chaos or nonlinear dynamics mathematical theory of medicine, health and disease refigures medical thought to provide better descriptive, explanatory and predictive models to achieve and provide improved health and care.*

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Science is not and should not be the sole factor in decision making; others such as moral values, are also crucial. But we need to go into these decisions with our eyes open to what is going on in the world.

Scientific American Editorial, Special Issue  
Crossroads for Planet Earth. Sept 2005.

The human race is at a unique turning point. Will we choose to create the best of all possible worlds?

Scientific American Editorial, Special Issue  
Crossroads for Planet Earth. Sept 2005.

Transformation is the essence of the journey...the instinct that drives us to wander...until we reach Ithaca, the place we started from, and through transformed eyes, see it again for the first time.

Arianna Huffington *The Gods of Greece*

***UPDATE December 2005***  
***Newer Ideas-Action Plan***

*a long year from Tsunami to mountain Tsunami*

From Tsunami to earthquake: bad year.

Global initiatives: good year.

Millennium Development Goals

Heart Health as  
a New Millennium Development Goal

Even *newer ideas* like ~

***Action Plan: Making a Better World***

It has been a long year of the Tsunami, a year of living dangerously. A lot has happened, much bad, and much good. The year is book-ended by the South Asian tsunami and the South Asian “mountain tsunami” earthquake, with hurricanes like Katrina, floods in Mumbai, Guyana and elsewhere, landslides in Vancouver and Guatemala, and many more natural disasters in between. Then there are the continuing wars, poverty and deprivation and social disasters like Paris burning, born of disparity and difference. There seems no end in sight.

But there is optimism, with many global initiatives and with the global heart of support and rethinking emerging.

There has been removal and reduction of debt burden for many low income countries, a renewal of the Millennium Development Goals, continuing global outpouring of support, the UN 2005 World Summit, Clinton Global Initiative, Time New York Global Health conference and picture essay, etc.,

*and even newer ideas, for global heart and  
for chaos and complexity.*

Beyond complexity to  
a new dynamic chaos~complexity

When I completed the first version of this book in February 2005 for our Valentine's Day Tsunami Heart Event, I suggested exploring the use of chaos *and* complexity science in making a better world, mentioning our decade and a half experience starting as far back as 1990, the infancy of this emerging field.

In this *long year of the tsunami*, a lot has changed and there are many exciting new ideas. Earlier in this book, I explained why I thought it important to retain the term *chaos*, rather than follow the increasing general practice of using the term *complexity*. There is an even better way of expressing this now, because of the tilde:

~.

~ suggests that we go *beyond complexity* – to a new *fractal, dynamic and adaptive complexity*, back to a new *chaos~complexity*, with a changing fractal balance of chaos and complexity as needed. This would return us to where we started, hopefully, seeing things with transformed eyes.

*This could also reconcile other polar opposites, which often stand in the way of making a better world.*

## ~ a balance between opposites

Scott Kelso at the Center for Complex Systems and Brain Sciences in Florida introduced me to the ~ which he and David Engstrøm propose as a symbol to indicate a balance between polar opposites, occupying a space somewhere between.

*I would add a dynamic, fractal and everchanging shifting between the two*, with the space between opposites filled with a probabilistic fractal distribution of either pole. Within each is self-similar but different probabilities of the opposite. Within each opposite is contained the other, to varying degrees and at varying depths. This is like order and disorder intertwined fractally throughout the universe.

We often frame the world as polar opposites, rich and poor, developed and less developed, healthy and not healthy, complexity and reductionism, and this guides how we approach change. They are however interrelated and often contained within each other. To make a better world we need a new thinking to bring together such polar opposites, to plumb the depths of new knowledge through reductionist science and to explore the nature of the complex multi level fractal web-like dynamic interactions we experience.

Reductionist scientists see complexity, but at a different degree and level, focusing on the parts to understand how they impact the whole; theoretical physicist Stephen Hawking and biologist EO Wilson claim that this century is the century of complexity, and Murray Gell-Mann, Nobel Laureate for discovering quarks, is one of the founders of the home of complexity – the Santa Fe Institute.

*Their complexity, it seems, includes reductionism.  
Their reductionism, it seems, includes complexity.*

*Why would we think otherwise?*

*Especially since, from as far back as the Big Bang, there are polar opposites contained in each other* – like order and disorder intertwined fractally in the universe. Genes and molecules are now considered dynamic, embedded in complex interacting systems and networks. ***Reducing anything simply changes the level of complexity***, preserving intertwined order, disorder and chaos.

Scott Kelso at the Center for Complexity and Brain Sciences and David Engström at MIT explain why, in “The Complementary Nature” (MIT Press – search web), implying that this may be inherent to nature and the human condition

with experimental evidence of our brain

“displaying two apparently contradictory, mutually exclusive behaviors at the same time”

a “*complementary nature inherent in human brains and behavior*,” which they suggest may explain ***why we (and nature) appear to partition things, events, and ideas into pairs.***

They ask, on the website: “Why do we perceive and interpret so many of life's contraries as mutually exclusive, either/or dichotomies such as individual~collective, self~other, body~mind, nature~nurture, cooperation~competition?”

They write that “Throughout history, many have recognized that ***truth may well lie in between such polar opposites***” and that this new idea would reconcile the scientific language of "states" with the novel dynamical language of "tendencies."

*This may have tremendous implications for some of the things that polarize us, such as peace, health, development and change, and thus for global heart.*

## Change and leadership

Leadership is difficult to define and its practice complex. It derives from the old English word *lithan*, meaning to show the way or guide.

The global heart emerging after the tsunami is an example of leadership and change, without a leader. Unless the leader is the process of emergence of the change – a chaos and complexity leadership.

David Kernick writes in *Complexity in Healthcare Organization* (Radcliffe Medical Press 2004) that the traditional function of a leader is to have an overview of the big picture and with the aim of directing and co-ordinating the activity of an organization.

He says that this is limited since organizations rarely do as they are told and leaders are less able to respond to the demands placed upon them – in charge but not in control.

There are many traditional leadership theories and thus methods to achieve change. These mostly include a visioning with a strong sense of the desired outcome, and establishing structures and means towards this end.

***Kernick says however that a system survives by not working to rule.***

## *Chaos~complexity leadership and change*

Newer leadership and change practice tends to include ideas consistent with chaos~complexity. It may not use these terms, but it incorporates many of the ideas as what seems to work best in the complex dynamics that ensnare us, and in particular in the complexities of the polarizations that tend to divide us.

Leadership and change is as much an art as a science. Margaret Wheatley writes, as far back as 1992 about this in her book “Leadership and the New Science: learning about organization from an Orderly Universe” with chaos and complexity the new art and science.

Kernick writes in a chapter on “Leadership and Change” in *Complexity and Healthcare Organization* that desirable leadership follows complexity ideas - is **transformational**, with the leader “sitting within the organizational network and need not be at the top of a formal hierarchical structure.” Such leadership includes emphasis on values, interactions, feedback and adaptation, diversity, multiple perspectives, patterns and context, with few rules, all facilitating emergence towards desired outcomes.

A balance is needed however, since we know that there are other kinds of leaders who are focused and very effective in achieving desired change. Returning to Scott Kelso and David Engstrøm’s ideas, there is room for a dynamic balance of different styles for leadership and change, depending on context and need.

*Chaos~complexity* provides us a new model for a dynamic balance of leadership styles, **a new art and science of leadership and change**, which can be used for making a better world.

## Science at the crossroads.

The September 2005 Special Issue of Scientific American “Crossroads for Planet Earth” Editorial is titled “Science at the Crossroads,” which could mean either

- 1) *science itself being at a crossroads*: reductionism changing to complexity, or to reductionism~complexity
- 2) *science* as we know it *at a turning point of the earth*: the demographic, environmental and economic transitions described.

Scott Kelso described the importance of reductionist science, often lost in the rush to complexity, while Lancet Editor Richard Horton spoke at the McMaster Lancet Peace through Health Conference in 2005, about the importance of social interactions towards health, often lost in the rush to reductionism. We need to balance both, dynamically, changing and adapting as needed, to solve problems.

The Scientific American article describes the science behind the major world problems facing us to 2050, with an *Action Plan for a Bright Future* outlined. Failing to follow this risks collapse, which the editors note happened to past civilizations with unsustainable ways, referring to Jared Diamond’s ideas in his book *Collapse*.

Polarizations may reduce somewhat the success of the Action Plan. The new thinking on reconciling opposites encourages optimism to “a bright future,” especially for Richard Horton’s challenge of science in the service of peace, health and development. The science for this should include *chaos~complexity~reductionism*.

The editors add however, that we need more than science in decision-making. Perhaps we need *heart~global heart*.

## The Dalai Lama's *more than science*

*The Dalai Lama invites us to use science, as well as more than science, in understanding and changing the world.* In his 2005 book *The Universe in a Single Atom: the convergence of science and spirituality*, he writes “I have argued for the need for and possibility of a worldview grounded in science, yet one that does not deny the richness of human nature and the validity of modes of knowing other than the scientific.”

The Dalai Lama continues, “I believe strongly that there is an intimate connection between one’s conceptual understanding of the world, one’s vision of human existence and its potential, and the ethical values that guide one’s behavior.” The Dalai Lama says that he believes that *spirituality and science are complementary* but different investigative approaches with the same goal of seeking the truth.

Although he mentions that many may consider spirituality and science incompatible, his explorations from his Science and Mind conferences and discussions at MIT and other scientific institutes lead him to suggest a collaborative endeavor between these two methods of inquiry, that he says has far-reaching potential to help humanity meet the challenges before us.

The Dalai Lama’s Buddhism includes modern science and modern physics. Also, the word *complexity* appears throughout his book, describing his personal views and also Buddhist thinking in a way that is entirely consistent with complexity science.

*The Dalai Lama’s Buddhism and his science include a complexity thinking.*

## How do we *think* the complex?

Carlos Gershenson and Francis Heylighen at Vrije Universiteit Brussel (<http://www.vub.ac.be/CLEA>) provide an elegant, detailed and yet easy to read synopsis of basic concepts, new vocabulary and language *to think and speak complexity, and ideas for its use in the complexities of the world*. They discuss the complementary nature of complexity and simplicity, entangled with each other, and suggest that shifting from classical to “complex” thinking brings both gains and losses. This reinforces the need to shift back and forth as necessary, adding complexity thinking to current knowledge rather than replacing it.

They describe the difference between what something is (abs-being) and its different representations or perceptions (rel-being), noting that a classical thinking executive would be bewildered by the multiple possible representations and management styles in an organization as: organism, machine, brain, community, market, ...and as a hierarchy, a network, etc. They suggest that, “*an organization has both mechanistic and organic aspects*, is simultaneously a cooperative, community and competitive arena, a rule-bound system and an open, creative environment, a hierarchy and a network...”

They suggest that complex thinking allows us to contemplate different representations at the same time, to achieve a less incomplete understanding. To tackle concrete problems, we choose the representation that is most appropriate for the context, shifting as needed to tackle problems.

***This moves us from thinking to acting the complex.***

## How do we *act* the complex?

*The Tsunami has opened our eyes to a new thinking - chaos and global heart, with new tools and fresh ideas to transform the world.*

We can use either the *usual* methods - the “*Industrial Age*” *ideas* of change we know or the *newer* “*Innovative Age*” *ideas* of a “complex management” with a wealth of choices (Sally Ann Swidler, UC Berkeley), *or both*.

Dee Hock, founder VISA, the largest organization in the world, which in retrospect was chaordic (chaos and order – search web for more) says “There is simply no way to manage the diversity and complexity of 21<sup>st</sup>-century society with 17<sup>th</sup> century concepts.”

*So, think, use and act*

*chaos~complexity~reductionism*

*heart~global heart*

*Find your comfort level and choose what works for you.*

*There are few rules: all contained fractally in*

*be guided by heart~global heart.*

## Heart~global heart consciousness

Global heart is a sense of caring, concern and connection, and requires few rules to practice. It goes beyond spirituality to a global or even cosmic consciousness. It takes us back to Chopra's "We are travelers on a cosmic journey – stardust swirling and dancing in the whirlpools of infinity." It could give us our place in the universe and meaning and telos for existence. Global heart may be the something deeper than many of us look for.

Historian Karl Jaspers identified the Axial Age, 800BCE-200CE, as a time "as if in response to a crying need, the great religious traditions either emerged or transformed...to embrace humanity," with a shift away from tribal collective to individualism and personal responsibility (reported by Elizabeth Debold in *What is Enlightenment* magazine Winter 2005– see web).

The emergence of science, rationality and reason, and now globalism takes us to a second Axial Age of global consciousness. Debold suggests that in our complex and interdependent world, we cannot develop commandments to cover all the difficult issues we face, and Karen Armstrong says we now need a new kind of religion – a contemporary moral and philosophical context for making sense of our lives."

The global heart emerging after the Tsunami is a global consciousness arising, emerging and self-organizing to fulfill this need. Chaos~complexity is its way of happening and the way to sustain it. It is a science with the moral and philosophical context for connection and responsibility, beyond individualism and spirituality, with few rules to cover everything, all contained fractally in *think heart~global heart*.

## Action Plan for heart~global heart.

Numerous organizations, individuals and the media provide opportunities for involvement, volunteering, learning and specific action. You can use these or make up your own – as Vanessa did, with her ideas for action, arising from volunteering in Sri Lanka described earlier in this book. She spent her birthday there and suggests gifts for birthdays and other occasions to help the world.

The *World Vision catalogue online* allows you to mark such occasions, or weddings, holidays etc, **with gifts that will change lives and change the world.** “your small change can change the world.”

A school class can collect pennies and change the world.

\$35 dollars = 2 rabbits  
 \$50 dollars = 2 hens and a rooster  
 \$100 dollars = 1 stocked medical clinic  
 \$150 dollars = 1 goat or 1 sheep

These gifts are bought locally, support people locally and continue helping. Goats give milk and meat and more goats and more milk and more meat. Your goat or cow or sheep or medical clinic will likely help you and the world more than more candy, chocolate etc.

UNICEF, Doctors Without Borders, and many other agencies now offer such opportunities to be part of the many ways to global heart.

## A new kind of lightbulb

Light bulbs above people's heads in cartoons represent novel ideas and flashes of insight. Cardiologist, Dr Ruth Collins-Nakai, President of the Canadian Medical Association, used the new energy saving light bulbs as a metaphor for change while asking for similar ideas that can change the world (see CMA Journal Dec 6, 2005). She implies that changing the lightbulb is not enough; it has to be a *new kind* of lightbulb, or *proposing a new approach*.

This book proposes a new approach - using chaos~complexity science to make a better world, based on over a decade of experience with this in medicine, health and society. This is a new kind of light bulb to, not only see the world differently, but to change the world. Stephen Hawking would agree, quoted in the Complexity Digest - *comdig.org*, that he thinks this century will be the century of complexity. The Complexity Society and the Open University will test this assertion at a February 2006 UK Joint National Conference on "The Application of Complexity Science to Human Affairs," just announced in the digest.

<http://www.complexity-society.com/programme.html>

Questions and topics on the agenda include:

*What can complexity science offer society? Getting value from IT - can complexity help? Complexity and innovation in communities - the conditions for change. Complexity and Educational Change.*

*What are the core issues and challenges in applying Complexity Science to Human Affairs? Issues for social scientists in providing evidence for policy and practice in a complex world.*

***A new kind of light bulb is now lit, applying complexity science to human affairs and everything else complex.***

## If we call it complex we should use complexity science.

Since we keep reporting the world as complex and interconnected, we should now learn how to create change in the midst of such complexity, not just in policy and evidence, or abstract or philosophical concepts, but in day to day living.

Jeffrey Rosenthal says in *Struck by Lightning: the curious world of probabilities* that our entire lives are governed by chaos, since small changes in the present can have a huge impact on the future. Steven Levitt and Stephen Dubner claim in *Freakonomics: a rogue economist explores the hidden side of everything* that unexpected and unrecognized things have unexpected consequences. Levitt and Dubner use economics, which they define as how the world works, to delve into the “stuff and riddles of everyday life,” turning conventional wisdom on its head with a new way of thinking.

Rosenthal says that “knowing the rules of probability, randomness and uncertainty allows us to make better decisions and to understand the world around us more clearly.” Similarly knowing chaos and complexity gives us a new way of seeing how and why things happen in the world and how best to effect desired change.

As a University of Toronto Professor, Rosenthal concludes his book with a Final Exam “Do you have Probability Perspective?” With questions in witty day to day language (no math), he shows how to use probability to make decisions in everyday living. ***A probabilistic chaos~complexity perspective for decision making would combine these two ideas as a way to change.***

## Probabilistic complexity action plan

This is a chaos ~complexity probabilistic model for decision making, for use from day to day living to large policy decisions. Rosenthal says we weigh risks and use probability in day to day life while Levitt and Dubner show the hidden side of everything.

Many choices are simple, easy and reflex. This model is for balancing risks for choices that are not easy or are complex.

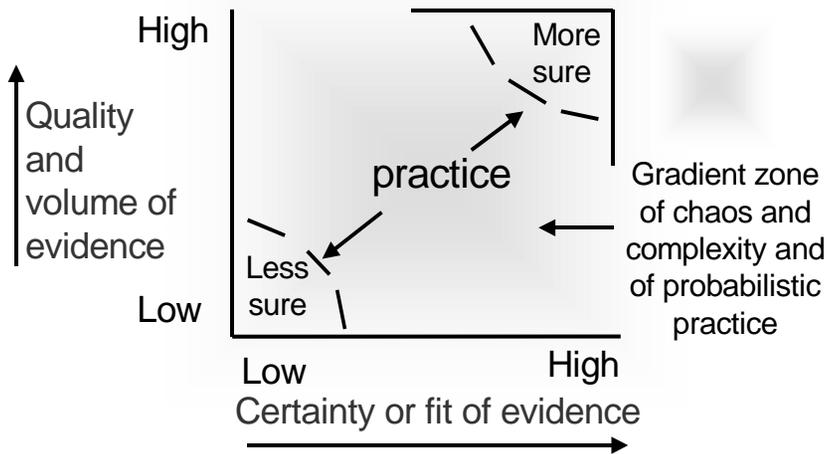


Fig. 1. Modified Stacey Diagram (VS Rambihar)

porous borders and probabilistic practice and chaos & complexity

Information or evidence can be used in a probabilistic fashion balancing risks, knowing how chaos~complexity works - with some uncertainty, sensitivity, leverage and amplification, as an Action Plan. Start with clear values, embrace diversity of ideas, make do with what we have and change and adapt as needed.

## Action Plan for the 21<sup>st</sup> Century

***A plan for a bright future beyond 2050***  
***Crossroads for Planet Earth, from the***  
*Scientific American* special issue Sept 2005

George Muser writes that three intertwined transitions - demographic, economic and environmental will transform the next few decades, posing problems on a scale humans have little experience with. We are at a bottle-neck, as EO Wilson puts it, a period of maximum stress on natural resources and human ingenuity. Muser's suggestions:

Understand the changes

Achieve Millennium Development Goals

Preserve crucial habitats, Wean off fossil fuels

Provide cheap irrigation to poor farmers

Improve health systems, Brace for slower growth

Prioritize more rationally

He says "depending on how we manage the next few decades, we could usher in environmental sustainability - or collapse."

*Note: Like Stephen Hawking, EO Wilson said that this is the century for complexity, and Thomas Homer-Dixon wrote the book on ingenuity (search web for the Ingenuity Gap: How can we solve the problems of the future.)*

To these we should now add sustaining global heart  
 and  
 improving global heart health.

## UN Millennium Development Goals

The eight Millennium Development Goals (MDGs)  
for 2015- from the United Nations website

**<http://www.un.org/millenniumgoals/>**

Eradicate extreme poverty and hunger

Achieve universal primary education

Promote gender equality and empower women

Reduce child mortality

Improve maternal health

Combat HIV/AIDS, malaria and other diseases

Ensure environmental stability

Develop a global partnership for development.

*These were developed by the United Nations as a global initiative of countries and development institutions in 2000 to respond to the needs of the world's poorest and most vulnerable. These goals were reviewed this year, and the target for achieving them is 2015.*

UN Secretary General Kofi Annan said at this review, "We will have time to reach the Millennium Development Goals – worldwide and in most, or even all, individual countries – **but only if we break with business as usual**.... We cannot win overnight.

Success will require **sustained action** across the entire decade between now and the deadline" (italics mine).

0.7% Solution: one of many things considered necessary. The MDG website says that few countries come close to the commitment to contribute 0.7% of income, which would achieve the MDGs. Search the websites to learn more, and to find out how you can help with this or other initiatives.

# Global Heart Health

## a new Millennium Development Goal

Global heart and global heart health are proposed in this book as new ideas and new tools for development. There is an initiative now to go further, ***to make the prevention of heart and chronic diseases a new Millennium Development Goal.***

World Heart Federation President Dr Valentin Fuster, and Janet Voûte, CEO, write that three of the MDGs are specifically focused on health, but that heart and chronic disease are omitted (www.thelancet.com Oct 29, 2005). They state that 35 million people will die worldwide in 2005 from heart and chronic diseases, ***80% occurring in low-income and middle-income countries.*** (17 million die of heart disease and stroke).

Lancet Editor Richard Horton, says that “Without concerted and coordinated political action, the gains achieved in reducing the burden of infectious disease will be washed away as a new wave of preventable illness engulfs those least able to protect themselves.” Kathleen Strong and colleagues, writing in *The Lancet* 2005 as part of a four part series “to fill a gap in the global dialogue about disease” according to Dr Richard Horton (Oct 29, 2005 www.thelancet.com), call for reducing deaths from chronic disease by 2% annually – to prevent 36 million deaths by 2015.

Fuster, Voûte, Strong, Horton and others call for ***making the reduction of heart and chronic diseases globally a Millennium Development Goal.*** *Globally* should include the relatively smaller, yet sizeable vulnerable populations at risk, in fractal patterns in high as well as middle income countries, recognizing a fractal distribution of disparity, disease, risk and need in all countries. Please search the web for World Heart Federation for more on this initiative, and for the Lancet articles mentioned.

## Make your best health to make a better world.

Reducing heart disease everywhere making a better world leads to an intriguing concept of inviting each of us and our communities to better heart health, as a way to make a better world. This works because of the complexity and interrelatedness across the world.

Increasing obesity worldwide now is leading to an epidemic of diabetes, heart and blood vessel disease. Although there are tremendous variation and disparities, heart and chronic diseases cross social, economic and ethnic boundaries worldwide and afflict vulnerable people in all countries. The benefits of averting the epidemic will extend beyond community and individual health to social and economic benefits to the community, and even globally, while making more funds and resources available for other needs.

Thus, one way to make a better world is to make the best health for yourself and your community; become fit, eat healthy and maintain a desired weight. In an interconnected world of complexity and sensitive dependence, this can have global impact. The little things we do for health can become big changes for the world.

Similarly, little things we do for heart, such as caring and compassion for the world, could well result in big changes globally, and help solve some of the big problems of the world.

Be the change you want to see in the world.  
Mahatma Gandhi

## ***Can we solve the problems of the future?***

Good questions stimulate deep thinking and a search for answers. The question above is the subtitle of Thomas Homer-Dixon's book *The Ingenuity Gap*, where he describes a **hyper-complex** and increasingly fast paced world "too complex and too fast-paced to manage."

He says "The challenges we face converge, intertwine, and often remain largely beyond our understanding. Most of us suspect that the "experts" don't really know what's going on and that as a species we've released forces that are neither managed nor manageable. This is the ingenuity gap, the critical gap between our need for ideas to solve complex problems and our actual supply of those ideas."

He adds "Poor countries are particularly vulnerable to ingenuity gaps, but our own rich countries are no longer immune, and we're all caught dangerously between a soaring requirement for ingenuity and an increasingly uncertain supply."

*Remember* Heinz Pagels quote at the beginning of this book: "I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century."

All nations thus stand to benefit from complexity science. Low and middle income nations and vulnerable people worldwide should benefit more. It may not make them superpowers as Pagels suggest, but it may well reduce the ingenuity gap and reduce the disparities now evident.

## Rethink the world.

Chaos~complexity allows us to rethink the world from the perspective of the web-like interactions, interconnectedness and nonlinear dynamics of how things work or do not work in the complex dynamics in which we live. This should then lead to a new way to create desired change, and a new way to peace, health, development...and everything else.

Not quite everything else, however. This thinking and usage has to be balanced by the need for some authority and centralized decision making and implementation by experts or by those to whom we entrust choice and leadership. For instance, the military, law enforcement, expert medical opinion and similar are subject to only limited innovation and distributed decision making, with its own lower levels of complexity. There is a need to balance these two complementary methods, changing according to need and context. The challenge is to know how and when to use which.

In business, society and human affairs that depend on rapid innovation, offer choice, shared decision making and feedback and adaptation, such rethinking becomes more important.

Gershenson and Heylighen suggest in “How we think the complex” (search web), that facing the complexity that surrounds us and is now our culture, forces us to change our ways of thinking. They claim that classical thinking with an emphasis on analysis, predictability and objectivity breaks down in complex systems and requires using complexity ideas to understand and to achieve change.

The complexities of the new world in which we live requires us now to rethink.

## Does rethinking achieve change?

2005 has been a good year to show that rethinking works.

The Melinda and Bill Gates Foundation Challenges in Global Health initiative (<http://www.gcgh.org/>) challenged scientists the world over to come up with innovative ideas to prevent diseases that kill millions of people each year in the world's poorest countries. Health and poverty eradication were directly linked and the vaccination projects it funded are estimated to have saved 700,000 lives in these countries.

Live Eight raised awareness, not funds, like Live Aid did 20 years earlier, achieving \$40 billion debt forgiveness and promise of more aid by pressuring G-8 Summit rich countries, money now available for infrastructure development, health, education, etc.

The Clinton Global Initiative achieved commitment for specific pragmatic solutions by bringing together world leaders, NGO's and others in a collaborative effort in New York in Sept 2005.

Describing the complexity and diversity of world problems Nancy Gibbs says that Bono and the Gates Foundation took on a task that was seen as too big and too complicated, really meaning complex (Time Magazine Dec 26, 2005). Recognizing that no one solution fits all countries, they used a model [for change] that “pulls in everyone, at every level. Think globally. Act carefully. Prove what works. Then use whatever levers you have to get it done.” They see poverty as a systems failure leading them to systems solutions, which in their hands is complexity.

Such real world solutions as what works, exhibit many features of chaos~complexity, showing that it can be used to make a better world. The impact of such rethinking in achieving change is so large that Time Magazine named Bill and Melinda Gates and Bono as Persons of the Year 2005, in recognition of their global heart.

## *Fractals and complexity at work in the world*

Poverty exists in fractal patterns worldwide and in some situations exhibits dynamics and multilevel fractal or self-similar interactions that lead to and sustain poverty, with implications for change.

Christopher Barrett and Brent Swallow describe the latter as a special form of poverty trap in *Fractal Poverty Traps*, World Development January 2006 (search web for full text), into which people may fall and have difficulty escaping. They describe multiple dynamic equilibria for poverty at multiple scales of analysis with self-reinforcing feedback loops, with self similarity independent of scale - features of fractal patterns and complex adaptive dynamics. They offer specific policy suggestions for poverty reduction in the context of fractal and complex dynamics.

Short term transfers to individuals, households, communities and nations, as is being done with the Millennium Development Goals.

Accessible transition strategies to change equilibria.

Public agency change to eliminate prohibitive thresholds.

Safety nets to prevent others lapsing into poverty.

Shared authority over resources and issues.

Thomas Friedman writes in his book *The World is Flat*, about the collaborative horizontal structures now emerging across the world. Admitting that the world is not really flat, he reports on the local and global multilevel collaborative and self-organizing efforts he observes and advocates for change, which is essentially complexity science at work in the real world.

## Blink, Think and Rethink

*Complexity is not for everyone. It certainly isn't for Michael LeGault, whose book "Think: Why Crucial Decisions Can't be Made in the Blink of an Eye," argues for factual knowledge, analysis and critical thinking in decision making. He is concerned about the Age of Emotion replacing the Age of Reason, with adverse consequences for society and the world. LeGault says that its time to wake up and think.*

*In his book "Blink: The Power of Thinking Without Thinking" Malcolm Gladwell asks us to hold the analysis and to take our instincts seriously in making decisions in complex situations. He feels that many such small choices to influence the way we do things will add up and make a different and better world. He says that there can be as much value in the blink of an eye as in months of rational analysis. This book reflects complexity ideas, with blink as the self organization and emergence or sum of influences.*

*This book says its time for both emotion and reason, which are contained fractally in each other, **to rethink and make a better world**. Our emotional response to the tsunami led to unprecedented global support, while critical analysis leads to new ways for aid delivery, reconstruction and sustained development. An emotional response to the crying needs there and everywhere else combines with a rational and critical analysis to fashion a future for the world.*

*Complexity science allows us to **rethink** the world, bringing together the mind and the heart, reason and emotion, so we can **blink, think and rethink**. As Blaise Pascal said "**The heart has its reasons, which reason does not understand.**"*

## *Complexity – not for everyone!*

Some people intuitively sense complexity, while others do not like it, leaving with a choice, to blink, think or rethink.

The website *Complexity made Simple* says that “Organizations which must follow standard procedures, like the military, police, or the courts system, cannot afford rapid innovation, to ‘make it up as they go along’ and that for business, nonprofit and those government agencies, which values innovation, it is very important and powerful.”

This may need some rethinking. Gladwell writes in “Blink” of military exercises where the team using a complexity type thinking won decisively, and then when as an experiment it adopted conventional strategy, lost decisively. Gladwell says we have to understand the links between the military, economic and cultural systems and their connection to personal relationships with future conflict fuelled by ideas, engaging cultures and economies. These are complex and dynamic interactions, even in the military.

There are complex interactions within the structures of most organizations that make them also subject, in a fractal way, to chaos and complexity, especially where there is choice, shared decision making, feedback and adaptation. However regimented the system, from the military to health, education and everything else, there are necessarily complex interactions and possibly fractal multilevel feedback, and thus chaos and complexity.

We should thus look for such interactions and patterns, and wherever we find them, consider a chaos~complexity perspective for change. Perhaps there is a fractal complexity everywhere, which can be used by everyone.

## Tsunami, Chaos and Global Heart

Science now includes chaos~complexity, the new science for society, humanity, leadership and change, which can be a model for the dynamic balance needed between usual and newer ideas, according to context, need and circumstance.

Change in the real world now reflects and depends on ideas from chaos~complexity, as what works. Such ideas have become usual and natural and part of mainstream thinking. It is thus timely to use chaos~complexity to make a better world.

Nancy Gibbs concludes her December 26<sup>th</sup> 2005 Time Magazine article on Persons of the Year – The Good Samaritans, with “In 2005 the world’s poor needed no more condolences; they needed people to get interested, get mad and then get to work.”

Josh Tyrangiel writes in the same issue of Time Magazine, 26 Dec 2005, exactly one year after the Tsunami, that one of the ways to spark a movement is to create a defining moment. On the 26<sup>th</sup> of December 2004, a ***defining moment*** was created for us, the chaos of the tsunami. A complexity type global heart movement was sparked, people got interested, got mad and then got to work.

Tsunami, Chaos and Global Heart invites you to remain mad, and to help sustain the global heart of support, sparked by the defining moment of the chaos of the Tsunami, using chaos and complexity to make a better world.

***After all, chaos in its original Greek meaning is a gap from which everything arose, much like the gap in the ocean floor that made the tsunami.***

**Conclusion:**

*use chaos~complexity*

*to*

*sustain the global heart emerging*

***by both the usual means***

*supporting existing agencies,*

*the South Asian tsunami and earthquake rehab*

*existing and new disaster relief and the many other*

*ongoing needs around the globe*

***especially the ones we hear less of***

***and in newer ways***

Make birthdays make a better world

*2 minute Global Heart*

*Valentine's Heart and Global Heart Day*

just thinking or talking about global heart

***exploring some of the ideas in this book***

***or in your own way***

*with creativity and ingenuity*

*By reading this you are already involved.*

2006

Review, one year later

2007

Review 2 years later p

More on Fractals

*It has been a **bad year** starting with the Tsunami of 2004, with many natural and social disasters like the Katrina hurricane, Mumbai floods, Guatemala mudslides, Paris burning, etc. But every year is a bad year for more than a billion people across the world, trapped in poverty, illness, insecurity and hopelessness.*

*How we see the world influences what we do. The **tsunami** has become a metaphor for **chaos** and **global heart**, showing us what we can do. A complexity perspective can help us to remove the distance and move us to make a better world.*

*Ransom Myers, an oceanographer on Fortune's list of 10 People to watch agreed he was "**using mathematics to reach the heart**" to change the world, when interviewed by Shelagh Rogers on CBC Radio Canada. This book aspires to do the same, but without the math, using just the **ideas from the new mathematics** of nature and society, to reach the heart.*

***Chaos** in 1975 became a new mathematics and physics of the real world, of the regular and irregular, turbulent, messy and uncertain, with complex and everchanging interactions changing everything - the right mathematics for the increasingly complex global interconnected and interdependent world of instant communication in which we now live.*

*The Tsunami came to us live as events never did before and we became part of the evolving story and part of the response almost immediately. Everything touches everything and touches the heart instantly. There is a new mathematics and physics for such things and how they happen, a new way of seeing this new world, with thus the need for new ways to achieve change.*

***Complexity** is a new science that uses the ideas and metaphors from the math of chaos to apply them to the world. So we do not need to know math, to use math to reach the heart and make a better world.*

*Thomas Friedman, author of “The World is Flat: A Brief History of the Twenty-first Century” writes that “in this new world the value-creation model is moving away from a vertical silo model to an increasingly collaborative horizontal model, from command and control to collaborate and connect, and that's going to change everything.” That's complexity in action in the real world. Friedman also says that the dynamic element of globalization is neither countries nor companies, but the individual, and that the unique thing about this era is going to be the ability of the individual to globalize.*

*I did not write much about “global” in this book, since global is very complex, can be both good and bad, and*

*thus requires its own global complexity book to do it justice. This book seeks to **globalize heart**, by using the inspiration of the global support after the tsunami to invite us to remain involved. And that kind of globalization should not be a bad thing.*

*Friedman quotes David Rothkopf, who says that what is going on today as globalization is not about governments or big business, but the emergence of completely new social, political and business models with “things that impact some of the deepest, most ingrained aspects of society right down to the social contract” or a transformation everywhere we turn.*

*Stephen Hawking says that he thinks the Twenty-first Century will be the century of complexity. Friedman’s *Flat World of the Twenty-first Century* describes such complexity everywhere around us. Our challenge as individuals or as fractals of our community, is to use this new complexity to sustain the global heart emerging after the tsunami and to make a better world.*

*Friedman finally concedes in Chapter 11 of his book that **the world is not flat**, using the expression “The World is Flat” to draw attention to the quickening pace of flattening in the past few years, and to explore ways to collaborate to overcome “constituencies, forces, or problems impeding further flattening,” including*

*preventing destructive flattening. He says that hope for many is to move from poverty to middle class, but that “there are hundreds of millions of people in Africa, rural India, China, Latin America and plenty of dark corners in the developed world with little or no hope, because they are too sick, or local government is too broken.*

*There is thus inhomogeneity of flattening. 700 million in India alone could be left behind, with millions in clusters and patterns elsewhere. Although there are large expanses within communities affected, there are peaks and valleys in the terrain of the flattening world. There are places with varying degrees of pockets within pockets of hope and darkness. Flattening and hope are fractal and a fractal perspective and response may be useful.*

*Flattening requires hope, which requires more than aid, infrastructure or policy change. It needs a change of heart, to facilitate or create conditions that will allow empowerment of people in their communities, collaborating at multiple levels to make the change they need. This is the essence of complexity, using insights from how the world works to make a better world.*

*Friedman’s Chapter 11 “The Unflat World” is a solemn reminder of the problems we face. He reports what is being done, with recommendations for change. The nature of the local and global multilevel collaborative*

*and self organizing efforts he observes and advocates, and many other features of how the world now runs in places, is essentially complexity already at work.*

*Time Magazine named Bill and Melinda Gates and Bono as Persons of the Year 2005, in recognition of their global heart. Referring to their efforts, Nancy Gibbs concludes her December 26<sup>th</sup> 2005 Time Magazine article on Persons of the Year – The Good Samaritans, with “In 2005 the world’s poor needed no more condolences; they needed people to get interested, get mad and then get to work.”*

*Josh Tyrangiel writes in the Time Magazine, 26 Dec 2005, exactly one year after the Tsunami, that one of the ways to spark a movement is to create a defining moment. On the 26<sup>th</sup> of December 2004, a **defining moment** was created for us, **the chaos of the tsunami**. A complexity type global heart movement was sparked, people got interested, got mad and then got to work.*

*There are many people and many organizations that have “got to work” after the defining moment of the tsunami – from schoolchildren saving pennies to million dollar donation from individuals and organizations, from self organizing local initiatives for education, health and society to government restructuring or waiving debt, from our creative involvement everywhere in the world,*

*to Bono and the Gates' contribution. All are valued,  
each crucial in a world of fractals.*

*It has been a good year for such support and what it has  
achieved. This needs to be sustained and improved, with  
new ideas added, to achieve previous goals, and to set  
and achieve new ones.*

*This book on Tsunami, Chaos and Global Heart pays  
tribute to everyone involved or interested, and **begins  
and ends by inviting you to remain mad, and to sustain  
the global heart of support sparked by the defining  
moment of the chaos of the Tsunami.***

*Your involvement now is as important as ever.*

*Sharmila Pathmanathan's lingering words in the Globe  
and Mail newspaper exactly one year after the tsunami,  
captures our sentiments best, bringing together the mind  
and the heart, inspiring us to make a better world.*

***"The memory of the tsunami stays in my heart."***

*Stephen Hawking said "I think the next century [21<sup>st</sup>] will be the century of complexity"*

Chaos and complexity provides a better explanation of the complex and everchanging interactions in the new fractal interconnected web-like world of rapid change we now live in. It provides newer ideas on leadership and change, and how things happen. Like the global heart emerging after the tsunami, it can thus be used  
***to make a better world.***

*"I am convinced that the nations and the people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century."*

Heinz Pagels, physicist, 1988.  
Former President NY Academy of Sciences

***update 2007***

*already*

## Complexity at work in the world



The global heart of support that emerged after the tsunami is an un-orchestrated global collaboration that exhibits many of the features of chaos and complexity.

Similar global collaboration emerging widely as social innovation, as what works best, has already profoundly changed the world. It now touches almost everything we do and has become part of the landscape.

The art and science of this collaboration and new thinking is complexity, features of which are now being designed into change projects.

There is now substantial experience and research evidence that using complexity works, and thus for us to use complexity science to rethink and make a better world.

In the short span of time since 1990 when we decided to use chaos and complexity in our projects, it has become widely accepted and successful enough to become the new thinking for this still new century.

***Stephen Hawking and Heinz Pagels were right after all.***

## ***Complexity already at work in the world***

There is now substantial **experience** with the use of complexity science ideas to make a better world. It is turning up in the most unlikely places. In “Getting to Maybe: how the world is changed,” Westley, Zimmerman and Patton show that many successful social innovations illustrate complexity features, citing poverty reduction in a developed country, improving palliative care, Bono, Geldoff and Grameen Bank and many others. They show that the “Rules of engagement” in social innovation, between volunteers, leaders, organizations, and circumstance are essentially complexity.

Muhammad Yunus describes social development from below in “Banker to the Poor,” with a methodology of mostly facilitated self-organization -few rules, feedback with adaptation and change, etc, all elements of complexity, as what works. His resilience in using the innovative idea of microcredit to achieve poverty reduction led to the Nobel Peace Prize 2006 being awarded to him and the Grameen Bank, linking peace to poverty reduction.

Tapscott and Williams describe in “Wikinomics: How Mass Collaboration Changes Everything” how Wikipedia, Linux, Amazon, IBM, Proctor and Gamble, Apple, Taking IT Global, web search engines and many other businesses, organizations, individuals and groups use global collaboration to create news stories, sequencing the human genome, designing software, curing diseases, and much more. Such global collaboration illustrates complexity features.

“Wikinomics,” and earlier books like “Open Business Models” and “Open Innovation” by Henry Chesbrough show how and when to use such open and “holistic” strategies, which have created a profound change in business, culture and society, radically changing the world. This is enabled by technology (Web 2 or

second-generation Internet as interactive rather than a repository of the world's knowledge), demographics (the Net Generation) and the global economy (a new global collaboration economics), which make a Perfect Storm for new models of production based on community, collaboration and self-organization rather than on hierarchy and control.

They call it *wikinomics*, with its art and science being openness, peering, sharing and acting globally. These four principles, they claim, increasingly define how 21<sup>st</sup> Century corporations compete – “very different from the closed, secretive and insular multinational that dominated the previous century.”

Similar global thinking emerges in British Prime Minister Tony Blair's discussion on Global Values in “Foreign Affairs” Jan/Feb 2007, writing “That is why on a whole range of critical issues, we face not just powerful questions about our national interests but also vital tests of our commitment to global values” and of “values in the common ownership of humanity, universal values that should be the right of each citizen.”

Thomas Homer-Dixon describes in “The Upside of Down: Catastrophe, Creativity and the Renewal of Civilization” a hypercomplex world, with ideas on how to choose a better route into the future. BW Powe tells us in “Towards a Canada of Light” of Canada as “a counter-nation of loose ties and subtle associations where dialogue, ideas, debate, and the exchange of information is the currency that holds us lightly together” - a fractal and complexity vision for a nation as “a new model and a work in progress.”

Prescott and Williams write in *Wikinomics* that “One thing that has not changed is that winning organizations (and societies) will be those that tap the torrent of human knowledge and translate it into new and useful applications.” Their current torrent is the new

collaboration with “as profound changes as the printing press, automobile and telephone that penetrate societies to fundamentally change their culture and economy.”

In “Apollo’s Arrow: The science of prediction and the future of everything,” David Orrell invites us to use our knowledge of complex dynamics in health, wealth, the weather and thus everything to guide us in making decisions, saying that “the future depends on the choices we make and on the reactions of complex systems that are beyond our control.” He suggests that we should not grasp for “illusory knowledge by over-modelling our environment” and use cultural and political values, keeping objectivity and subjectivity in balance in decision-making.

Westley and coauthors also suggest that ways of seeing could change ways of doing and that influencing *perspective* could influence practice and thus progress. They use the term *maybe* in the title of their book as “a defiant claim of possibility in the face of a status quo we are unwilling to accept.” They say that transforming the world is possible because the complex forces of interconnections that make systems resistant to change are the same forces that can be harnessed to propel change.

***Hawking and Pagels are prescient.***

***The complexity rethinking is already happening, as a new perspective on everything and a new way for transformation. We have an opportunity now to tap into this current torrent to make complexity global. This would be a truly global collaboration, making available the choice to explore and use complexity to rethink and make a better world.***

***Be part of this global collaboration  
towards a global heart.***

## **Towards** a global heart

BW Powe has captured the essence of fractals, chaos and complexity without using those words. I read his book "A Canada of Light" (1993, 1997) around 1998, and sensed that he was writing about **a nation as fractal, complex and dynamic**. His book, revised for 2006 as "Towards a Canada of Light" captures this sense even more, describing a **nation as a process**, constantly changing and evolving with interaction and feedback from across the nation. Global heart is similar, for the world.

Recent debate over a nation **within a nation** - the motion passed in Parliament of Canada "That this House recognize that the Québécois form a nation within a united Canada" highlights the need for new meanings, models and metaphors, for a new era of complexity, or hypercomplexity as Homer-Dixon describes.

Fractals, chaos and complexity richly depict the complex and dynamic interactions that make up a nation, and a nation within a nation, reconciling the different perspectives, giving validity to all, to differing degrees, captured by the new term *fractal*. **We are a fractal nation, everchanging and diverse and entire.**

**Qu'est-ce qu'une nation?** Ernest Renan asked in 1882 at a conference in the Sorbonne, France. Reminds us of the surrealist movement and Ceci n'est pas une pipe (This is not a pipe), words below the image of a pipe painted by Magritte, as a contradiction, that is actually true – a paradox, an idea within an idea: the painting is **not** a pipe - it is an image of a pipe. Ceci n'est pas une nation. It is a process, an idea that can be transferred elsewhere.

**Qu'est-ce que global heart?** It is a **process**, of interactions across the world, of ideas and actions, reshaping other ideas and actions, a complex, dynamic, chaotic mix and dance that hold us together – **towards a world of heart – global heart.**

References: 2007: Selected **BOOKS** and a letter:

Apollo's Arrow: The science of prediction and the future of everything. D Orrell. 2007. HarperCollins. Toronto. Use the knowledge of unpredictability of complex systems to make decisions for the future.

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The Upside of Down: Catastrophe, Creativity and the Renewal of Civilization” Thomas Homer-Dixon. 2006. Alfred A Knopf, Canada. Describes a hypercomplex world, with ideas on how to choose a better route into the future.

Towards a Canada of Light. BW Powe. 2006. Thomas Allen Publishers. Toronto. Canada as “a counter-nation of loose ties and subtle associations where dialogue, ideas, debate, and the exchange of information is the currency that holds us lightly together.” Essentially a fractal and complexity vision for Canada as “a new model and a work in progress.”

Banker to the Poor. Muhammad Yunus. 1999, 2003. Public Affairs. New York. **Nobel Peace Prize 2006** awarded to him and the Grameen Bank for “social development from below.” His methodology was mostly facilitated self-organization, few rules, feedback with adaptation and change, etc, all elements of complexity, as what works. Peace linked to poverty reduction.

**Make Obesity History: complexity science for complex issues. Rambihar VS, Rambihar N.** 2006. Response to Oct 24, 2006 Commentary by Sonia Anand. Use complexity ideas, like those used in Grameen Bank, as “micro level health promotion from below” for obesity reduction and chronic diseases.

*“Nothing gives life more purpose than the realization that every moment of consciousness is a precious and fragile gift.”*

*Stephen Pinker  
Johnstone Professor of Psychology at Harvard  
in Time, Jan 29, 2007*

Chaos and complexity provides a better description of the complex and everchanging interactions in the new fractal interconnected web-like world of rapid change we now live in. It provides newer ideas on leadership and change, and how things happen. Like the global heart emerging after the tsunami,  
it can thus be used  
***to make a better world.***

Fractals – the patterns of chaos and complexity

*we no longer live in a Global Village  
we now inhabit a fractal world.*

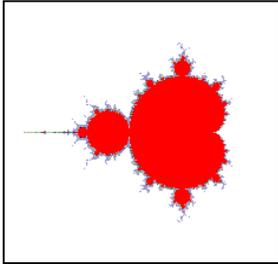
## MORE ON FRACTALS

To be alive is to participate in the dance of chaos.

Greg Allen. Sustainable Edge

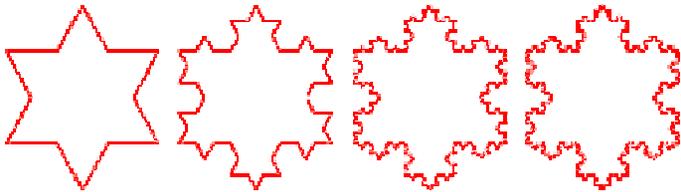
...you can't put everything under control. To be alive is to participate in the dance of chaos. ***We need to negotiate with chaos, not try to banish it.***

Greg Allen. Sustainable Edge

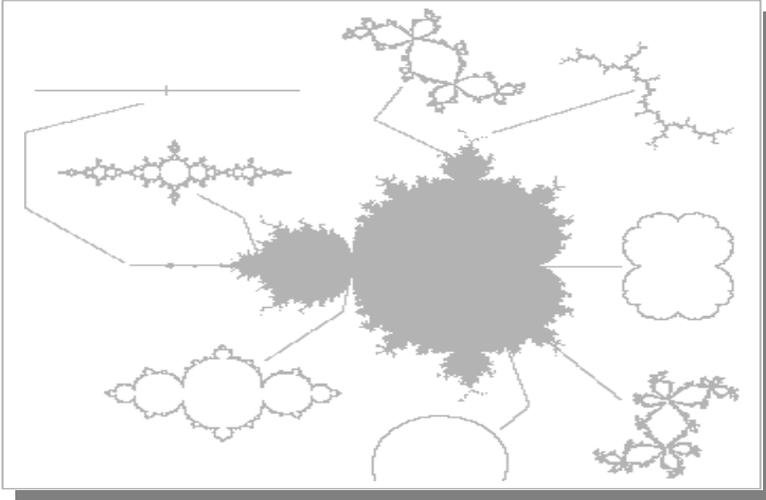


***This is a Mandelbrot set fractal.***

*Magnifying any part reveals a similar structure to this image, self similar, but not entirely exact. A more complex looking fractal shows the dynamics or ever changing nature of the image, but still keeping the basic shape, with a different kind of differences, **always a part and the whole at the same time, diverse and entire.***



*Fractals, chaos and complexity provide **new meanings, models and metaphors** for identity, diversity and our complex dynamic interactions, which empower each individual and each group in our local and global diversity, and in our **fractal world** in a land of complexity, or our fractal land in a world of complexity.*



**Fractals** represent the patterns of chaos—the science of complex adaptive systems like ecosystems, with novel function and relationships, which provide a model for our interactions with each other, individually or in groups.

**Such systems** display nonlinear dynamics with strong and weak interconnections and interdependencies, balancing cooperation and competition at multiple levels, with sensitive dependence or the power of small inputs to change outcomes.

**They illustrate** interconnectedness and our interdependence on each other and our environment, and the power of small changes locally and globally to shape our shared future on a fragile planet, with limited resources.

**This encourages** going beyond promotion of mutual respect and accommodation to empowerment of everyone, ensnared in the same web of network connections.





*about the authors*

Vivian S Rambihar is a Toronto cardiologist since 1980, a 1975 graduate of McMaster University Medical School, with specialist training in Internal Medicine and Cardiology at McMaster University and at the University of Toronto.

Sherryn Rambihar graduated from the University of Western Ontario Schulich Medical School in May 2005 after undergraduate studies at the University of Toronto.

*Both of the authors above were influenced by chaos and complexity thinking during medical school, one in the early 1970's at McMaster, which pioneered a self-directed, facilitator guided, emergent learning and the other at Schulich Medical School, with an ecosystem approach, for which chaos and complexity could be its basic science.*

Vanessa Rambihar is a student in Health Science at the University of Western Ontario, former Head Prefect at Havergal College in Toronto and traveled to Sri Lanka in summer 2005 as part of a Havergal College Tsunami project.

notes

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