According to the physicist David Bohm [8], "not only is everything changing, but everything is in constant flux. That is, what exists is the creative process itself: all objects, events, bodies, conditions, structures, etc. are forms which can be absorbed by this process". This summarizes the progressive, variable, even dissipative nature of reality from the viewpoint of quantum physics. In his article about reality and knowledge, D. Bohm compares such concepts to currents of water, where the infinite forms of eddies, ripples and waves never exist in isolation: they can only be comprehended as abstractions of a total flux of movement.

In Greek mythology, it was this "total flux" which sustained the well of memory and the spring of all knowledge, belonging to "Mnemosyne". She was one of the titans, and the first woman in pre-literate history to exist before the division of the earth and heavens. While transporting the dead on their journey to the kingdom of shadows, the river Lethe robbed them of all memories and knowledge, in order to feed the well of Mnemosyne.

Hermes, the titan's adoptive son, led the chosen ones (gods and poets) to this wellspring of memory, where the muses would offer this worthy "liquid", so that they might "drink" the knowledge of others. But when Prometheus gave humanity the gift of writing, this spring of memory ceased to flow, and the muses became trapped in literature [9].

Once more, the media "currents" have been freed, and the muses have returned to Mnemosyne's well of memories. Hermes has retired now, and the spring of memory flows through telecommunication networks which link images, text and sound in new multimedia, polyphonic ways.

Every day, eager to drink the waters of cyberspace, more than 50 million navigators dive into the virtual wells of Mnemosyne, to consume the knowledge and savor the taste of distant memories. At the turn of the millennium, this virtual ocean plays an increasingly important role in our everyday lives, and in the entire structure and organization of society. It is the means of transport, communication and creation par excellence: a breeding ground for egos and echoes of all kinds.

Like the "primeval soup" [10], the evolution and survival of information and communication in the oceans of cyberspace depends to a large extent on the interactive and organizational capacity of its components. The new "molecular" structures of post-biological life are being formed on the Internet's waterways.

And from the "infinite" possibility of combinations, other "species" arise: other forms and contents which grow and group together, as if they were living organisms. They feed, grow, develop and disappear, just like Bohm's waves and whirlpools in the total flux of movement.

NOTES

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THE CURRENT TREND IN COOPERATION AND DEVELOPMENT

ALBERTO SÁNCHEZ-BAYO

If the blue planet's heat is controlled by means of the major mass of water of which it is comprised, providing an atmosphere suitable for the life of the beings which inhabit it; cooperation must serve as a warm current in the setting into order of the relationships among individuals, social groups and cultures, smoothing over any discrimination involved in living together within a framework of tolerance. Far from seeking a rationally perfect model of individual or society, *cooperation for development* must aim at enriching individuals and cultures through constant contact and communication among them, conveying values and knowledge and respecting the traits of individuality which make up their own identity within this melting pot of races and cultures comprising the geography of mankind. Hence, as water takes on the flavor and aroma of whatever is dissolved in it, our lives must be permeable to those of other individuals and cultures so as to acquire new outlooks and progressively more subtle shades of nuance as part of a process of constant renewal.

FLOWS

BY WALLACE S. BROECKER

A river carrying 100 times more water than the Amazon is difficult to comprehend. Its flow would be 20 million cubic meters of water per second. Only if the daily rainfall for the entire Earth were funneled down a single channel could such a river be created. No such megariver has ever existed, of course, but such a flow does exist in the ocean. We scientists refer to it as the Great Ocean Conveyor. Instead of coal, this Conveyor transports heat from the warm regions of the Atlantic to the region around Iceland and dumps it into the frigid Europe-

bound Arctic air masses. As a result, the winters experienced in northern Europe are often milder than those in the region around New York City where I live. The outbreaks of Arctic air which often blast the region come via a continental route and therefore have no chance to suck heat from an ocean kept warm by the Conveyor.

This marvelous heating system is part of the ocean's large scale circulation system. The deep sea is flooded with cold water which originates at two places on our planet, one in the northern Atlantic (in the vicinity of Iceland) and the other in the Southern Ocean (along the margins of Antarctica). That produced in the north flows through the deep Atlantic and passes around the tip of Africa where it joins the waters cascading off Antarctica's ice-laden continental shelves. Driven by strong westerly wind, the mixture created in this way swirls round and round Antarctica as the deep portion of what is known as the Circumpolar Current. During each pass of the southern limit of the Indian and Pacific Oceans, some of this mix floods northward 'ventilating' the deep portions of these giant water bodies. To complete the circuit, waters upwell to the surface and find their way back to the deep water source regions.

What drives this global river of the sea? First of all, because cold water is more dense than warm water, the surface waters in the polar region are able to sink and take up residence beneath their less dense counterparts which cap the tropical and temperate regions of the ocean. Even though this density stratification has been accomplished, the sea is not at rest for its warm upper waters driven by winds and tides are stirred downward into the abyss gradually dedensifying the waters of the deep sea. This allows the cold surface waters in polar regions to continually invade, underriding the interior stack. Once established, this pattern of circulation perpetuates itself. As it now operates, the global circulation system yields particular benefits to those countries downwind from the region where deep water forms in the northern Atlantic, for it is here that immense amounts of tropical heat are dumped into the otherwise frigid Arctic air masses.

Knowing this, an evil minded Dr. No or Mr. Goldfinger might seize on the idea of threatening a shutdown of Europe's giant heating system. He would demand a 100 billion dollar ransom from European Union. "Otherwise", he would snarl, "Iceland will freeze over, the Scandinavian forests will revert to tundra, Ireland will become like Spitzbergen..." But if spurned, how could our villain fulfill his threat? To force such a shutdown, he would have to flood the northern Atlantic with a catastrophic burst of fresh water. Only if he could suddenly divert the entire volume of Great Lakes water or flash melt Greenland's immense ice cap could he make good on his threat. Were this accomplished, he would so dilute the salt (an important densifier) in the surface waters of the northern Atlantic that even in peak winter, its waters would not become dense enough to sink to the abyss. Once stopped, the Conveyor would not restart. The reason is that rather than being quickly swept away by the Conveyor, the fresh water supplied by precipitation and by rivers would pool, creating a permanent fresh water lid similar to that which exists in today's Arctic.

Of course, there is no way that even masterminds of No's and Goldfinger's caliber could get their hands on enough fresh water to carry off such a threat. Nature herself, however, has pulled off this feat. About 12,500 years ago when the world was enjoying a warm respite after many, many millennia of glacial conditions, the Conveyor suddenly shutdown, plunging northern Europe back into frigid conditions. This cold epoch, known to geologists as the Younger Dryas, persisted for about 1200 years at which point the Conveyor popped back into action.

The onset of this millennial duration cold snap appears to have been triggered by the catastrophic release of water stored in a lake which covered much of what now is Canada's Manitoba Province. This event occurred during the period when the Laurentian ice sheet, which during peak glacial time covered nearly all of Canada and the northern USA, was melting away. The lake formed in a depression created by the weight of a two kilometer-thick ice mass. Its northern shoreline was cut into this retreating front mass. Initially, the outflow from the lake drained to the south down the Mississippi River. Then, one day a breakthrough occurred at the lake's northeast corner allowing its diverting outflow to escape to the east through the valley of the present-day St. Lawrence River into the northern Atlantic. As the new outlet was several tens of meters lower than the old one, a vast amount of water deluged to the Atlantic. Nature accomplished what our evil villain could only dream of. No longer were the winter waters sufficiently dense to sink to the bottom and the Conveyor came to an abrupt halt.

The Younger Dryas was not the only punctuation of climate attributable to stoppage of the Conveyor. As recorded in Greenland ice, about 15 such events occurred during the course of the last glacial period. While a few of these were likely triggered by massive surges of ice launched into the Atlantic from a lobe of the Laurentian ice cap centered over Hudson Bay, the others were probably the product of an oscillation in the salt content of the Atlantic Ocean. During times of extreme cold when the Conveyor was off, the ice caps in Scandinavia and Canada grew larger, thereby holding back the input of fresh water into the Atlantic. As a consequence, the salinity of the Atlantic gradually increased, eventually reaching the point where the Conveyor sprang back into action. Once reactivated, the heat released to the atmosphere over the northern Atlantic would cause the ice sheets to melt back. As a consequence, the salt content of waters in the Atlantic would be gradually drawn down. This would continue until the Conveyor could no longer function. It would then snap off. A new cycle would follow.

While there is no way that a Goldfinger or No could force a shutdown of the Atlantic's Conveyor, it might be said that together we, the inhabitants of Planet Earth, are doing our utmost to make it occur. How so? The threat stems from our seemingly insatiable desire for energy. As most of this energy is derived by burning coal, oil and natural gas, we currently release each year about 23 billion tons of CO_2 into the atmosphere. About one half of this CO_2 remains airborne. The rest is sucked up by the ocean and terrestrial biosphere. Consequently, the atmosphere's CO_2 burden is rising at the rate of about one half of one percent each year. Prior to the Industrial Revolution, the CO_2 content of our air was 280 parts per million. It's now up to 365 parts per million. By the year 2025, it will likely reach 415 parts per million. If by that time, we have not begun to rein in our ever expanding energy use and turned heavily toward non-CO_2 emitting energy systems, the level could easily reach 560 parts per million by the end of the 21st century. The problem is

that CO_2 is one of the so-called greenhouse gasses which act to hold in Earth heat. Climate models suggest that a doubling of CO_2 will warm the planet by about 2.5 degrees Celsius. When the greenhouse impacts of methane and nitrous oxides are added to that of CO_2, the warming at that time may reach as much as 4 degrees.

So what does this have to do with the Conveyor? Two things, both of which will tend to decrease the density of waters in the polar regions (and therefore in the northern Atlantic). First, the polar regions will gradually warm. Second, as the planet warms, more water will evaporate from the oceans and consequently more rain will fall. At high latitudes where precipitation exceeds evaporation, this increase will dilute the salt content of surface waters. Hence the greenhouse buildup will produce a double whammy! Climate models which simulate the response of the ocean as well as of the atmosphere suggest that once the global warming reaches 4 degrees Celsius that there is a distinct likelihood that the Conveyor will shutdown.

Let's say that our man-made greenhouse warming push in a century or so pushes conditions in the northern Atlantic over the brink. What would a world without the Conveyor be like? If we adopt what happened when the Conveyor shut down at the onset of the Younger Dryas as an analogy, then the region around the northern Atlantic would cool dramatically. Further global rainfall patterns would undergo a dramatic shift just as happened during this year's El Niño. Storminess would likely increase. But, fortunately, conditions on Earth would not deteriorate to the extent they did during the Younger Dryas. The reason is that at the time of a greenhouse induced shutdown, the Earth would be several degrees warmer than now. Rather more likely, while temperatures downwind from the northern Atlantic would drop below today's, in the rest of the world the cooling would merely offset part of the accrued greenhouse warming.

So, one might conclude that such an event would not be so awesome after all. After the reorganization was complete, after some accommodation to the new conditions, life would go on much as before. Perhaps, but the transition period would likely be a very unpleasant one. By analogy to any of the reorganizations recorded in Greenland ice, during the transition period climate would undergo large flickers. These flickers would continue for several decades before climate finally settled down into its new mode of operation and would be fast enough and frequent enough to make a shambles of agricultural planning. With a projected 9 to 10 billion people to be fed from lands which now stretch to feed only 60 percent this number, these flickers could be disastrous. As their course would be unpredictable, crop failures due to swings in rainfall patterns could well lead to massive starvation.

Our captains of industry don't want to believe even that CO_2 will significantly warm the Earth. They certainly don't want to listen to Chicken Little's cry that the Conveyor might stop. They justify their reluctance by quoting the one reputable atmospheric dynamist who pooh-poohs greenhouse warming. MIT's Richard Lindzen feels strongly that the increase in atmospheric water vapor central to the warming predictions will not occur. If he is correct, then indeed there is no problem. But stacked against Lindzen's scientific intuition are the results of all climate models. The other 100 or so reputable atmospheric dynamists take these model results seriously and are concerned that the water vapor feedback will boost CO_2's impact several fold. Of course, until the Earth's response (or non-response) to rising CO_2 sends a clear message as to whether the model simulations or Lindzen's intuition is correct, the debate will continue. During the 20 or so years which will pass before a conclusive observational result is in, it would be prudent for us to diligently prepare to meet a possible need to greatly reduce CO_2 emissions during the second half of the 21st century. Past climate records kept in ice and ocean sediments sends us the strong message that the Earth's climate system is an angry beast. We are poking this beast. Beware!

WHIRLPOOLS

MARIO SATZ

The force of the earth's rotation on objects is known as the Coriolis Effect. This effect follows the model of Ferrel's Law, which holds that all moving bodies tend to veer toward the right in the Northern Hemisphere and toward the left in the Southern Hemisphere. For example, it is why an observer may be surprised to find that water drains in one direction in Australia and in the other direction in Europe (although the observer himself is subject to the double helix of his genetic code). Because of the Coriolis Effect, biological asymmetry loosens the geometric exclusivity of circular forms, opening them into heliocoids: this is the model for osseous, corneal and calcium growth, found in a kneecap, a ram's hollow horn or a gastropod's shell. Spirals are driven by a dancing force, either ascending or descending, whose emotional transcription lies between vertigo and ecstasy: in their presence we feel vaguely drawn in or absorbed. The sensation is irresistible and complex, yet it obeys a rule as simple as that of the whirling dervishes of Konya.

The spiral is to geometry what the whirlpool is to water. In air or in a vacuum — a column of smoke or a galaxy — ethereal matter displays an evanescent discontinuity which transports us from a minimum to a maximum via the opening up of our senses. The same pattern or model occurs beneath water's transparent and homogenous silk, as if the liquid were acquiring a form based on a vibrating conical irregularity, and as if there were something orgasmic and genetic about the centrifugal force caused by the whirlpool. In Spanish, to drain oneself is also a good way of referring to the climax of the love act. Simply stated, a spiral is a curve that begins at a point of origin, from which its curvature continuously diminishes [1]. It is a curve whose concave radius increases constantly, and (as in erotic experiences) as its power grows its motives are revealed, like echoes of a voice that had only moaned. The spiral, like the whirlpool, is a line that travels, the most nomadic and ambiguous of all forms.

T. A. Cook [2] studied ruminants' horns and mollusk shells — those drawings and arrangements that according to