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Features

On the Cover: The Colorado River, photo courtesy of Creative Commons; cover design by Alan Yue.

News

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Address all correspondence to **21st Century**, P.O. Box 16285, Washington, D.C. 20041.

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Without the U.S., It's 'Fusion Never'

The recent annual meeting of Fusion Power Associates again reminded us that the momentum toward achieving fusion power has shifted from the "traditional" fusion nations—the U.S., Europe, Russia, and Japan—to the nations in Asia. But for reasons which are much larger than the fusion program, without a fundamental change in U.S. policy, the great promise of fusion power is not going to be achieved anywhere in the world, anytime soon.

At last year's fusion meeting, Dr. G.S. Lee, who heads the fusion program in South Korea, described in detail the ambitious research and development project under way at the KSTAR tokamak.

This year, the most anticipated talk at the Washington, D.C. meeting was that of Professor Yuanxi Wan, Dean of the School of Nuclear Science and Technology in Hefei. China's EAST experiment is the first fully superconducting tokamak in the world, and, like KSTAR, is preparing the manpower and industrial expertise for the introduction of fusion energy power plants over the next decades. China is currently pursuing an ambitious nuclear fission building program, and Dr. Wan described China's multi-decade transition from fission to fusion.

By contrast, the fusion program in the United States continues to fight for its life, held together only by the resilience and optimism of its very capable scientists and engineers. Rather than push the boundaries of knowledge and accelerate the development of this revolutionary potential energy source, our Department of Energy spends tens of billions of dollars to clean up "waste," and attempt to turn back the clock to the time of pre-industrial societies, which used solar energy and wind to eke out their meager existence.

But Not Without the U.S.A.

Yet it is a delusion to suppose that the shortcomings in the U.S.A. program will be made up for by the enthusiasm and determination of China and Korea. Given 20 to 30 years of "business as usual," it might even be possible for these nations to achieve the long-sought goal of commercially viable fusion energy. But we do not have 20 to 30 years, perhaps not even that many weeks.

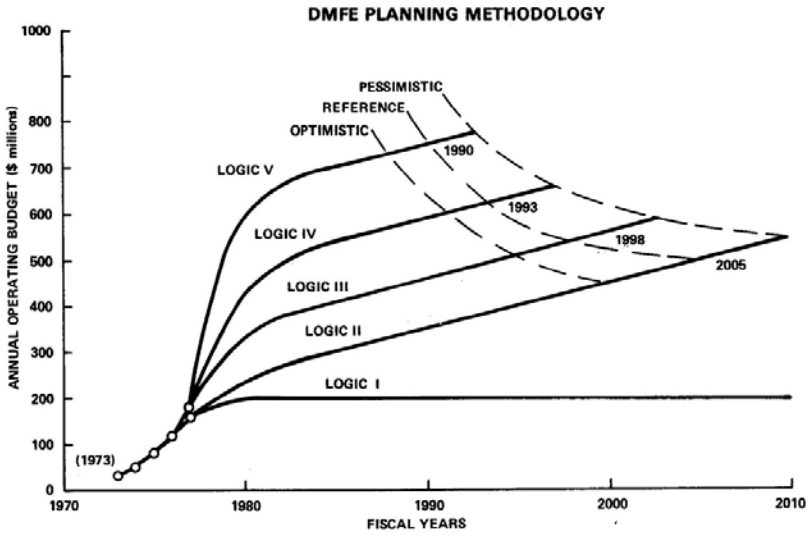
The future is being determined by a global conjunctural crisis in the world financial system for which there has been no precedent in history. Behind that crisis in paper is the physical economic fact that we are not producing sufficient means in basic industrial output, even foodstuffs to properly supply a growing world population. We need the energy flux density of nuclear fission power now, and fusion as soon as we can get it, in order to address precisely that problem.

Without a commitment to high-technology economic progress within the United States and the leading technological powers of Europe, there is no future worth thinking about for the entire human race. There is only a descent into a new dark age of disease, hunger, and holocaust. To avoid that, we must immediately reverse more than 30 years of destructive "green" policies respecting energy, industry, and science as a whole. It means adopting the essential points of LaRouche's policy, including a financial reorganization based on the Glass-Steagall separation of deposit banking from speculative activity, and a fixed-exchange rate monetary system (New Bretton Woods).

Losing Our Credibility

The present course of the United States respecting fusion is illustrative of the problem which infects every aspect of essential scientfic policy.

Addressing the Fusion Power Associates meeting, Dr. Edmund Synakowski, a scientist with two decades of experience in fusion research, who now heads the



WHAT IT TAKES TO REACH FUSION— AND 'FUSION NEVER': ERDA'S LOGIC IN 1976

In 1976, the Energy Research and Development Administration (ERDA), the predecessor to the Department of Energy, published this chart showing the required fusion operating budgets to reach a working magnetic fusion reactor. Each option was called a Logic, and each had three variations from optimistic to pessimistic. With $600 million a year, as shown in Logic V, the program would have been able to operate a demonstration reactor by 1990.

Logic I, which represents the actual fusion budgets from 1976 to the present, produces fusion never, as shown.

For more detailed information, see "The True History of The U.S. Fusion Program And Who Tried To Kill It," by Marsha Freeman, Winter 2009/2010. www.21stcenturysciencetech.com/Articles_ 2010/Winter_2009/Who_Killed_Fusion.pdf .

Source: ERDA, 1976

Office of Fusion Energy Sciences at the Energy Department, laid out in stark terms, the dire situation that is facing the U.S. fusion program.

The "present investment is a fraction of what is needed," in terms of government funding, he stated. But there is no possibility, in the current budget climate, which he described as the "tension between science and deficits," that there will be support for a next-generation U.S. fusion machine. As a result, the U.S. will have little to offer for cooperation. And if there is not any "serious engagement" with the rapidly-advancing Asian nations, we could "lose our leadership position" in fusion, Synakowski warned.

Considering the effort that is being made, particularly in China, India, and South Korea, and the fact that there is no funding planned for new, more advanced experimental facilities in the U.S., Synakowski concluded that, the U.S. is "only one breakthrough away from losing credibility" in the international fusion community. This, for a nation to which every developing nation, including China, historically turned for assistance in fusion research.

The United States, as is increasingly clear, is not the only nation facing dissolution of its financial system, as part of the global breakdown now occurring. As ITER costs have increased, the European Union, which, as the host institution must provide 45 percent of the funding for the nearly $20 billion project, has been unable to agree on how to meet that commitment. Do not look to Europe for great advances, Synakowski stated. The "EU financial system has been in flames over the last half year."

Fusion 'Never'

Dr. William Brinkman, Director of the overall Office of Science at the Department of Energy, reported at the FPA meeting that the European Union is now outspending the U.S. in all physical science research. "We need to double the science budget," he stressed, while at the same time reporting that last year, Congress cut the budget for all energy science funding.

For magnetic fusion energy research, the fiscal year 2009 budget enacted was $394.5 million. Later, an additional $91 million was pumped in for a one-time boost from the Recovery Act. In FY10, which ended on October 1, 2010, the funds appropriated were $426 million. Considering that the magnetic fusion energy budget was higher than that *in 1982*, in real terms, the fusion budget is nearly half its mark of nearly thirty years ago.

Last February, the Administration's fusion request for FY11 was $380 million, down $100 million from two years ago; and this, nearly a year before the new Congress—dominated, with help from the White House, by an irrational, and destructive hysteria over cutting federal funding to "balance the budget"—even takes their assigned seats.

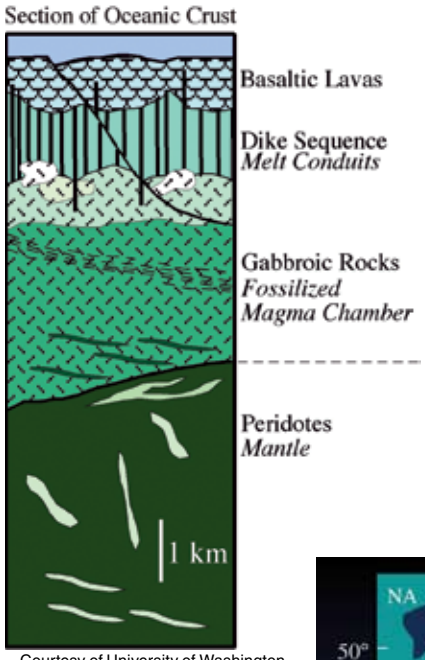
Thirty-five years ago, fusion scientists and government officials laid out a multi-decade plan to achieve the operation of fusion energy power plants. Funding profiles were provided, indicating the level of support that would be required, to build and operate the experiments and new engineering facilities to reach that goal.

The higher the funding level, the more rapid the progress. At $600 million per year, a demonstration fusion reactor was projected to be operating by 1990. At the lowest funding level, of about $200-300 million per year (in 1976 dollars), fusion would be reached "never."

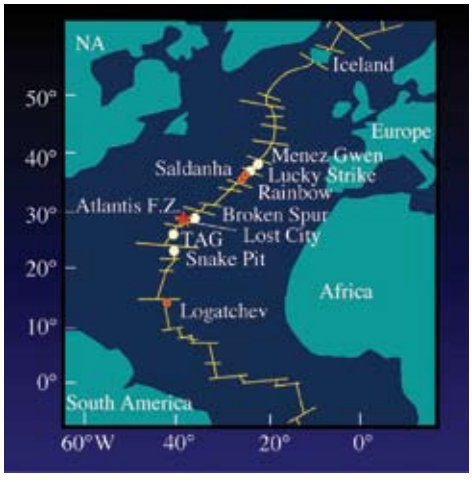
Since the mid-1980s, the fusion program has generally hovered around the "fusion never" funding level.

The world has no choice, but to move toward a qualitatively superior energy platform, which has a virtually infinite fuel supply, and can provide electricity, high-quality heat, plasma for industrial processing, and a range of frequencies of radiation across the electromagnetic spectrum for applications to everything from medicine to space travel. The alternative is a future so hideous as to be unthinkable.

—Marsha Freeman



Courtesy of University of Washington



Generalized diagram showing the various "layers" of rock that make up the oceanic crust. At the Atlantis Massif, gabbroic rocks have been uplifted close to the seafloor, allowing sampling in a region of the crust normally beyond reach. Right: the Lost City hydrothermal field is located near the top of the mountain (red star).

MORE EVIDENCE FOR DEEP HOT BIOSPHERE REVEALED AT ATLANTIS MASSIF

Scientists sampling for organisms beneath the Atlantis Massif, a huge uplift of the oceanic crust in the central Atlantic Ocean west of the Mid-Atlantic Ridge, reported the discovery of bacteria in the gabbroic layer overlaying the mantle, where average temperatures were slightly above the boiling point of seawater.

The majority of organisms found by the international team seemed to be hydrocarbon metabolizers capable of feeding off of methane and toluene, although nitrogen fixers and sulfate and metal reducers were also found. The hydrocarbon metabolizers were genetically very similar to bacteria found in oil reservoirs and other hydrocarbon-rich areas. In fact, several were almost identical with cultured species from these sources.

In the Deep Hot Biosphere hypothesis, advanced by astrophysicist Thomas Gold and others, life begins below the planetary surface, among organisms capable of metabolizing hydrocarbons, sulfates, and other available chemicals, and only later evolved systems, such as photosynthesis, for survival on the surface. Gold also believed that liquid hydrocarbons originate from the action of bacteria and Archaea on methane welling up from deep in the Earth's mantle. Astrophysical evidence had convinced Gold that conventional theories of geology had to be reworked to take account of the Earth having formed by aggregation of already cooled proto-planetary material.

At the Atlantis Massif, the ordinarily deep crustal layers have been thrust up to only 70 meters from the sea floor, and in many places the mantle has been exposed. The samples harvested after drilling to depths of 4,564 feet showed that bacterial species were widespread but sparse in the sampled layer. Unlike the microflora of the basalt regions of the ocean crust, the gabbroic layer had no Archaea.

The spectacular thermal vent was discovered in 2000 on a cliff of the Atlantis Massif, by a National Oceanic and Atmospheric Administration (NOAA) expedition. The hot mineral waters supported a complex ecosystem of Bacteria and Archaea of novel types, and the expedition called it "the Lost City of the Atlantis Massif." The existence of hydrocarbon metabolizers within deep crustal layers suggested to the researchers that it is in such subsurface regions of Mars that we should be looking for life.

Both aerobic and anaerobic bacteria were found in the samples. The genetic similarities with several surface hydrocarbon metabolizers suggests that the organisms have not been long isolated from each other, and that within disparate hydrocarbon-dominated environments, certain bacterial taxa are generalists, able to survive and to potentially degrade hydrocarbons in a myriad environments, including deep subsurface igneous rocks, such as those analyzed in this study. This is in contrast to earlier sampling in basaltic ocean crust, which found novel bacteria and Archaea specialized for endolithic life.

The report of the discovery appears in the online journal *PLoS ONE*, (www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0015399).

CHINA PLANS FUSION-FISSION HYBRID REACTOR

Speaking at the annual meeting of Fusion Power Associates, Chinese plasma physics expert Yuanxi Wan explained that even with the breeder reactors that China is building, China will not have enough uranium to fuel its ambitious nuclear power program 50 years into the future. Therefore, fusion scientists have proposed to design and develop a Fusion-Driven Hybrid Multi-Functional Reactor, which would use the neutrons produced by the fusion reaction to breed new fuel for fission reactors at the same time that it produced energy, Academician Wan told the meeting in Washington, D.C. on Dec. 1. The hybrid reactor could also be of benefit to the "back end" of the nuclear fuel cycle, by transmuting what cannot be reused, from spent fuel. If the

Chinese government approves the project, the scientists hope to begin development in five years. Wan represents the Institute of Plasma Physics in Hefei, China.

The fusion-fission hybrid concept dates back to the 1950s, and was explored in the U.S.A., before the turn to green fascism shut down most advanced nuclear and fusion research. The principle of the hybrid is to use the excess neutrons produced by a fusion reaction, to set off a fission reaction in a surrounding blanket of fissionable uranium. Unlike a conventional fission reactor, the fusion-fission hybrid consumes almost all the uranium fuel, without the need for enrichment or reprocessing. In an ordinary fission reactor only the U-235 isotope, which might make up about 5 percent of the uranium in the fuel, undergoes fission to provide power. The remainder of the uranium, in the form of the U-238 isotope, is wasted unless it is bred into new fissionable fuel by irradiation with neutrons. Other forms of breeder reactors can also accomplish this.

The fusion-fission hybrid system will be effective even if the fusion reaction is not working above energy breakeven, and thus provides a useful transition to full-scale fusion power. Recently revived programs at Lawrence Livermore National Laboratory and the University of Texas are exploring hybrid technology, using, respectively, laser and tokamak (magnetic confinement) systems for achieving fusion.

An interview with Academician Wan will appear in the Winter issue of *21st Century Science*.

Marsha Freeman

Academician Yuanxi Wan: We have to look 50 years ahead.

NAWAPA TAKES OFF WITH CONFERENCES AND EXPERT PARTICIPATION

The North American Water and Power Alliance project is getting off the ground with the enthusiastic participation of science and engineering experts across the country. *21st Century* readers are invited to view the many interviews with experts posted on the LaRouchePac website, along with the video coverage of the recent Los Angeles and Kennewick, Wash. regional conferences at www.larouchepac.com/nawapainterviews .

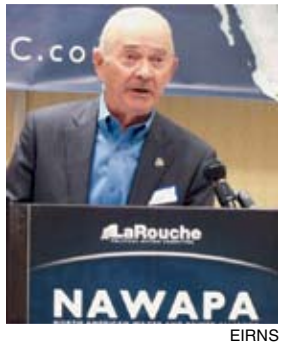
The revolutionary NAWAPA project would transform America and the global economy, Apart from delivering water from Alaska and Canada to water-starved regions of the American West and Mexico, NAWAPA will create new waterways from the Great Lakes to the Pacific and Arctic Oceans, unleash a renaissance of nuclear power and high-speed and maglev rail development, and quickly create 4 million new skilled jobs and job-training opportunities in the U.S.A. Physical economist Lyndon LaRouche has proposed NAWAPA as the leading edge of a global revival of industrial and agricultural potential that would also include major infrastructure development projects such as the Congo River/Lake Chad development project, the huge Eurasian Land-Bridge program, and a Bering Strait bridge/tunnel and Darien Gap development project that would eventually connect Eurasia to the tip of South America.

EIRNS

LaRouche PAC leader Michael Steger (at podium) moderated the Dec. 4 NAWAPA conference in Pasadena, Calif. Steger called NAWAPA the antidote to the multi-decade cultural downshift that followed the death of President Franklin D. Roosevelt.

By organizing the experts who will lead the program and the citizens who will participate in it, even before it has been adopted by a backwards Congress and Administration, LaRouche Pac is making NAWAPA a reality that will pull American and the global economy out of an otherwise irreversible collapse. The interviews are diverse and broad-ranging. Among the many interviews are: Civil Engineer Elghi E. Segovia, discussing his extensive experience constructing dams and other water projects in the Himalayas and South America and what we can learn from this to implement NAWAPA; Civil Engineer Tom Taylor, discussing his experience working under permafrost conditions in Prudhoe Bay, Alaska; Rail Engineer Hal Cooper, talking about the proposed world land-bridge of high-speed rail and related infrastructure corridors; Joseph Montgomery, Senior Staff Geologist, Murrieta, Calif., discussing the geology of the NAWAPA project area and NAWAPA's potential to revolutionize geological sciences; and John Sparlin, U.S. Army Corps of Engineers (Ret.), reviewing the engineering considerations in approaching a project like NAWAPA.

Readers are welcome to join the NAWAPA discussions, by contacting the NAWAPA "Basement" team at basement@larouchepac.com .



EIRNS

Nuclear expert Dewitt Moss, addressed the Tri-Cities NAWAPA conference in Kennewick, Wash., discussing nuclear power and its essential role for economic development.

NASA

Dr. Walter Haeussermann, second from left, in a 1961 meeting with Dr. Wernher von Braun and his management team. Inset is Haeussermann in 2008.

NASA

Peter Jenniskens, meteor astronomer at NASA Ames Research Center and the SETI Institute, and Mohammed Alameen, a student at the University of Khartoum, point to the first meteorite from asteroid 2008TC3 found, after two hours of searching, on Dec. 6, 2008. They use aluminum foil to prevent contamination. Inset: Closeup of a meteorite.

IN MEMORIAM: DR. WALTER HAEUSSERMANN (1914-2010)

Dr. Walter Haeussermann, one of the few remaining members of Wernher von Braun's rocket team, and a collaborator of the Schiller Institute, died in Huntsville, Alabama on Dec. 8, at the age of 96. He played a crucial role in the development of the world's first guided missile, the German wartime V-2, and in the Apollo program that took Americans to the Moon.

Soon after earning his doctor in electrical engineering in 1939, Dr. Haeussermann was drafted in to the German Army, where he worked on the guidance and control of the A-4 rocket. After the war, he came to the United States under Operation Paperclip with the von Braun team, and he established and led the Astrionics Laboratory at NASA's Marshall Space Flight Center. The rocket team was confident that its Saturn V rocket could safely launch astronauts into space, but Dr. Haeussermann's guidance and control lab had to make sure the rocket would land on the Moon precisely where planned.

While most of the rocket team concentrated their contributions in science and engineering, Dr. Haeussermann also became active in civic and political affairs in Huntsville. In 1984, when the German space pioneers learned that Arthur Rudolph, their colleague and Saturn V rocket manager, had been terrorized into leaving the country under threat of prosecution for Nazi war crimes, Dr. Haeussermann became the public spokesman for the group's fight against the outrageous charges. Dr. Haeussermann organized support for Rudolph's exoneration, and co-authored an op-ed with *21st Century* Associate Editor Marsha Freeman, which was published in space periodicals.

Walter Haeussermann was a part of the generation that, through all of the privations of the Depression, World War II, and the attacks on their contributions in the post-Apollo United States, never lost their optimism that space exploration would be mankind's future.

NEW STUDY: 'GREEN' WATER TREATMENTS FAIL AGAINST BACTERIA

A University of Pittsburgh study of non-chemical treatment systems touted as green substitutes for chemicals like chlorine suggests that these systems are ineffective. According to a Dec. 10 university press release, researchers found that the green systems "can allow dangerous bacteria to flourish in the cooling systems of hospitals, commercial offices, and other water-cooled buildings almost as much as they do in untreated water." The two-year study of five non-chemical treatment devices found that "none significantly prevented bacterial growth." The researchers found that the standard chlorine treatment, "controlled these organisms, even after bacteria had been allowed to proliferate."

NUBIAN DESERT ASTEROID (2008 TC3) YIELDS METEORITE TREASURE TROVE

The 13-foot asteroid that crashed into the Nubian Desert in October 2008 has provided an international team of scientists with at least 10 different types of meteorites, including those with polycyclic aromatic hydrocarbons and amino acids, which are considered "building blocks" of life. It had been assumed previously that the molecules of these amino acids would have been destroyed in the strongly heated fragments of the asteroid.

The asteroid 2008 TC3 was the first celestial object to be observed and tracked prior to entering the Earth's atmosphere. A recovery team of 150 students from the University of Khartoum in Sudan searched the impact target area and recovered nearly 600 meteorite fragments, weighing more than 23 pounds total.

"Right from the start, the students were surprised to find so much diversity in meteorite texture and hue," said Muawia Shaddad, an astronomer at the University of Khartoum, who led the search effort. The asteroid was estimated to weigh about 59 tons, with about 86 pounds surviving the explosion in the atmosphere.

Most of the fragments, scientists determined, are a rare type of meteorite called ureilites, which comprise less than 10 of the nearly 1,000 known meteorites. This was the first time that freshly fallen mixed composition ureilite has been found. The international research on the meteorites is featured in several papers published in a special issue of *Meteoritics and Planetary Science,* in December 2010.

NAWAPA, From the Standpoint of Biospheric Development

by Sky Shields, Oyang Teng, Michelle Lerner, Cody Jones, and Ben Deniston

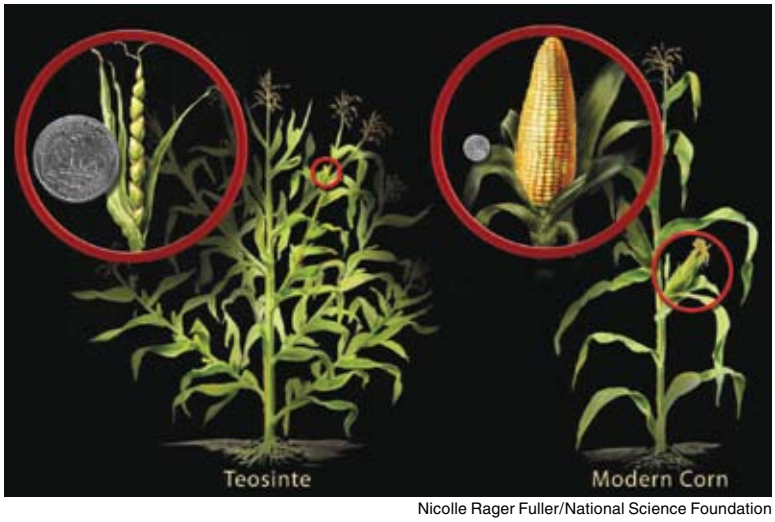
Scott Bauer/USDA-ARS

Mahantango Creek watershed near Klingerstown, Pennsylvania.

The current crisis is not a financial one, or even a physical one, in the simplest sense. We are not facing a lack of finances, or a lack of resources. We are facing a crisis of human culture, of which the current U.S. President and his predecessor are merely exemplary. It is time that we analyzed more deeply the roots of the erroneous thinking which have led us into this current disaster, in order that we might avert it in the only way possible: by turning our sights once again towards humanity's future, and returning to the cultural-philosophical roots of a true science of physical economy.

When man "builds infrastructure," he is not simply placing some object called infrastructure into an empty box. He is actually reorganizing the physical space-time of the Biosphere, as a system, by transforming and redirecting the biogenic flows through the Biosphere, allowing it to attain higher and higher levels of energy flux density. The simplest example of this, is the introduction of farming and animal husbandry: The apples, corn, and livestock of today are far different, and far more efficient, in terms of energy density, than their wild counterparts which reflect the state in which man first encountered them.

Photosynthesis, which converts the diffuse energy of incident sunlight into the concentrated form of chemical bonds, creates both the difficult-to-digest cellulose of plant stems, as well as the easily accessible energy stores of carbohydrates and other organic molecules. This process is a part of what Russian-Ukrainian biogeochemist V.I. Vernadsky



Nicolle Rager Fuller/National Science Foundation

Teosinte represents the state of corn at the time man first encountered it in the wild. Only a very small portion of the bushy plant contained the nutrients and digestible material that make corn the staple it is today. The highly nutritious, and energy-efficient food that we now call corn is entirely a creation of early man's projects in biological engineering and, like the similarly human-engineered modern cow, will not survive outside of human care.

called the biogenic migration of atoms—the continuous flow of matter through the Biosphere as the result of living processes, creating higher and higher levels of organization in the secreted fossil materials. Man's action on apples, corn, and livestock, for example, increases the ratio of usable carbohydrates, lipids, and proteins to the expensive (in terms of energy), but relatively useless (for consumption) cellulose of the plant's structural components.

Ultimately, the survival of the human species will depend on man's ability not only to organize these flows and increase their efficiency, but also, to create, from scratch, the environment of biogenic flows which he requires in order to live outside of Earth's atmosphere, and to colonize our Solar System and beyond.

The North American Water and Power Alliance (NAWAPA)[1] program will be among the first of man's projects to willfully redirect those larger processes determining the further evolution of the Biosphere, as a whole, serving as the reference point for such challenges as establishing permanent settlements on other planets, such as Mars. Again, this will be achieved through further understanding and redirecting these biogenic flows, but now, on a much grander and more fundamental scale.

This biogenic migration of atoms is more than a mere flow of material "within" the Biosphere. It constitutes the very structure of the Biosphere, and governs the nature of Earth's interaction with phenomena outside of the Earth's atmosphere, such as solar and cosmic radiation.

The Creation of Earth's Atmosphere

To take a useful example: The creation of Earth's oxygen atmosphere by life not only caused a massive change in species on the face of the planet—rendering the vast majority of then-existing life forms extinct, while paving the way for more complex, oxygen-breathing life forms—it also changed the Biosphere's interaction with the Sun's electromagnetic radiation (specifically in the "ultraviolet wave range"), creating a higher degree of structure within the Biosphere—the ozone layer—which, in turn, further moderates which frequencies of electromagnetic radiation would be allowed to enter Earth's developing Biosphere to affect planetary evolution.

This biogenic migration of atoms also caused the development of the ionosphere, the highly energetic zone which, by its interaction with the solar wind and Earth's magnetic field, is responsible for the creation of the aurorae, and which can at times act as a massive particle accelerator, deter-

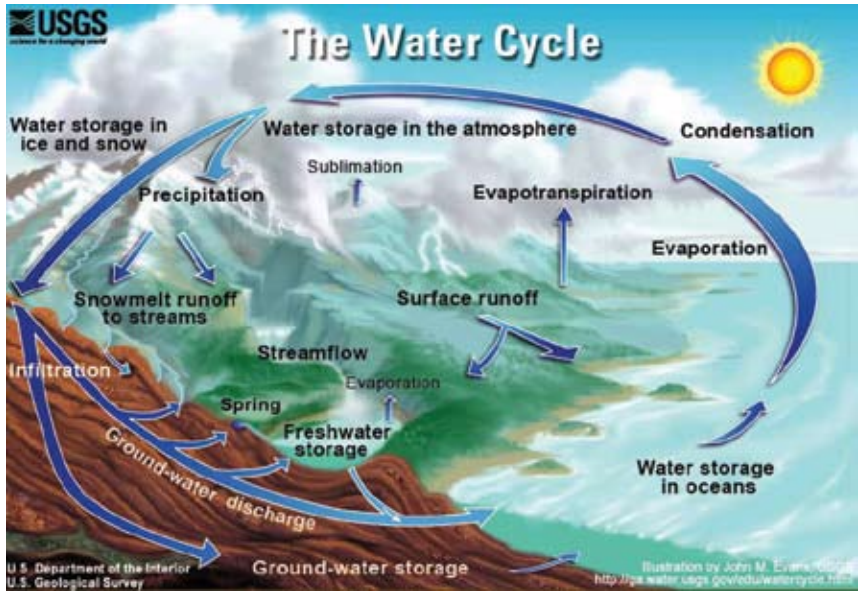
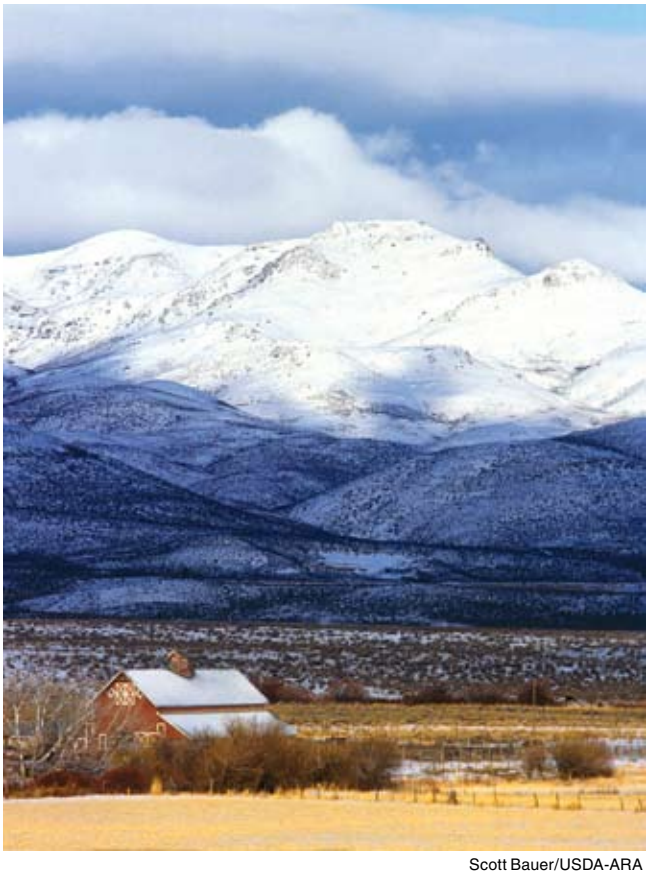


Figure 1
SCHEMATIC OF THE WATER CYCLE

The idea of the so-called "water cycle" is a useful abstraction, showing the general flow of water between ocean and land. In reality, this cycle contains numerous subcycles, and is inextricably connected with other "cycles" of carbon, nitrogen, and so on. Together, the complex system forms what V.I. Vernadsky called the "biogenic migration of atoms."

Source: USGS

1. See "The Tennessee Valley Authority of the 21st Century," by The LPAC Basement Team, *EIR*, Aug. 6, 2010.



Scott Bauer/USDA-ARA

Globally, the same water falls an average of 2.7 times on land before returning to the sea, and at a higher rate where vegetation is dense. Here, the Reynolds Creek Experimental Watershed in the Owyhee Mountains, southwest of Boise, Idaho.

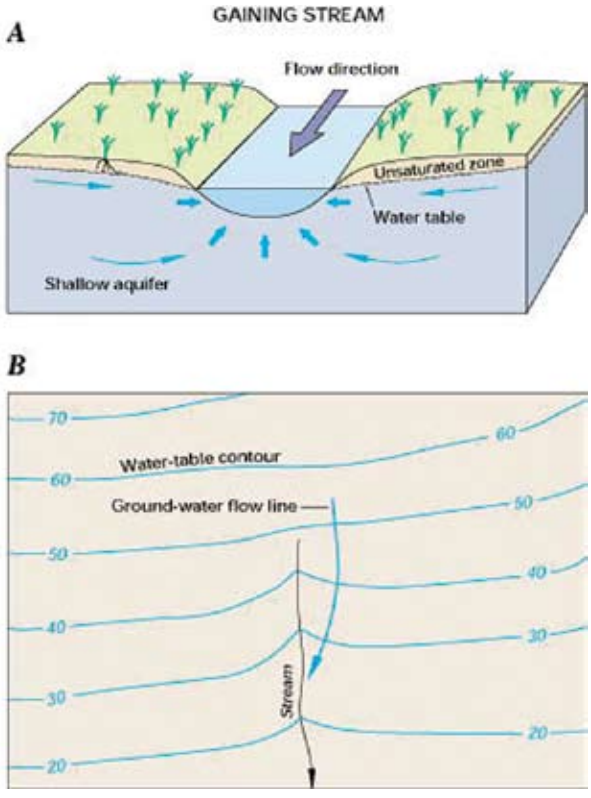


Figure 2
INTERACTION OF GROUNDWATER AND STREAMS

Surface water and ground water are not two distinct phenomena. Rather, they form a single, complex flow of water and associated minerals, characterized by abrupt discontinuities which delineate sharp changes in flow intensity and direction. **A***: A flowing body of water, gaining volume all along its length from a connected aquifer.* **B***: The gradient associated with an aquifer's flow lines, compared to the direction of the flowing surface water, shows whether the stream is replenishing the aquifer or vice versa.*

Source: USGS

mining what types of cosmic radiation will be fed down onto the Earth's surface. Some of this radiation would be involved in producing the cloud cover which moderates the Earth's temperature and produces precipitation.[2]

Certain aspects of this process of biogenic migration of atoms are popularly broken down, for ease of understanding, into several oversimplified cycles: the "water cycle," "nitrogen cycle," "carbon cycle," etc. At low resolution, these do, in fact, appear as simple cycles, but when viewed more closely, they form an interconnected network, a system, whose causal interrelations are impossible to represent linearly. Changes in the nitrogen concentration of soils, caused by perturbations in the nitrogen cycle, change the rate of carbon fixation in plant life, perturbing the carbon cycle, which in turn changes the rate of photosynthesis, perturbing the oxygen and water cycles, which in turn perturb the nitrogen cycle, and other biogenic flows of atoms, etc.

Even within a single one of these so-called cycles, the amount of complexity quickly reaches a point where the description requires a systems approach—a tensor description—particularly when we wish to discuss the conscious manipulation of such a system.

Taking water as an example: In first approximation, at the lowest resolution, we can describe the water cycle as a simple process, beginning with sunlight's effect on the ocean surface, causing evaporation. This evaporated water rises into the atmosphere; some of it migrates over land and falls as precipitation. This precipitated water then makes its way, over time, back into the ocean, by way of streams and rivers.

Upon closer examination, this process really consists of many interconnected sub-cycles, where water plays its most important role, in facilitating the growth of plants. In this process, there is no clear beginning, nor are there any simple linear or cyclical relationships. Plants consume both water and sunlight, using them to produce oxygen, and to fix CO_2 into energy-dense organic molecules. The moisture which these plants release in transpiration then rises up to become cloud cover, feeding and enhancing the precipitation which had permitted their growth originally.

2. One might, in fact, consider this entire process to be the creation of a sort of biospheric infrastructure, where biological fossils continually provide the conditions for more advanced creative processes.

If the vegetation becomes dense enough, this additional atmospheric moisture is enough to change weather patterns, alter the landscape, and reshape the course of rivers. At various stages of this process, large amounts of water enter the soil, to either be evaporated again into rainfall, or to be sucked deep down into the groundwater stores which form a continuous system of exchange with the above-ground lakes and rivers.

The result of this is that, globally, the same water falls an average of 2.7 times[3] on land before returning to the sea, and the rate is obviously higher in areas of dense vegetation. Further, as the groundcover and soil moisture change, so does the reflectivity of certain parts of the Earth's surface, which, in turn, transforms how sunlight is absorbed and changes its effects on temperature and evaporation.

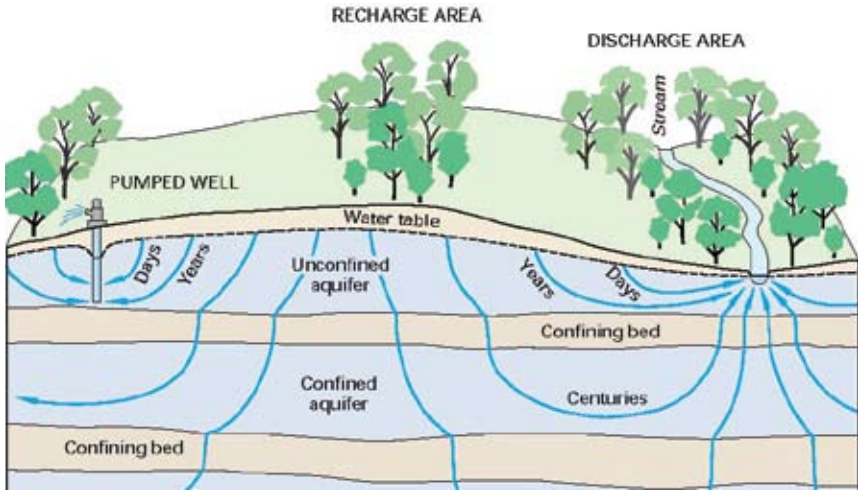


Figure 3
SCHEMATIC OF INTERCONNECTED SYSTEM OF GROUND WATER AND SURFACE WATER

Source: USGS

The number and types of interrelations are vast, but perfectly comprehensible to the human mind, when aided by the proper conceptual tools. In fact, their thorough comprehension is the destiny of the human species, since the mastery—and replication, in an improved form—of their complex interrelations will be necessary in order for man to achieve his destiny of colonizing interplanetary and interstellar space. Already today, spacecraft designers must attempt to recreate portions of the oxygen, carbon, and water cycles in miniature, in order to maintain crews on their trips.[4] The same process, at much higher levels of complexity and efficiency, and combined with a deeper understanding of the role of cosmic

3. Lev S. Kuchment, "The Hydrological Cycle and Human Impact On It," in "Water Resources Management," *Encyclopedia of Life Support Systems*, 2004.

4. As an example, take the limited example of water, oxygen, carbon, etc., recycling on the International Space Station.

Earth's Atmosphere

Our planet is sometimes unimaginatively pictured as a rocky sphere to which a thin layer of gas tenuously clings amidst the vacuum of space. Far from that bleak prospect, the Earth's surface represents a particularly intense region of transformation of the cosmic radiation which permeates all of space. In our neighborhood, the vast majority of this radiation is emitted by the Sun, which produces a large spectrum of electromagnetic frequencies, as well as a constant stream of electrically charged plasma called the solar wind.

The solar wind, guided by the Sun's magnetic field, is involved in a constant interaction with the plasma that constitutes the upper regions of the Earth's atmosphere and Earth's own, constantly changing, magnetic field. This complex interaction produces highly structured phenomena such as the Van Allen radiation belts and the aurorae, while the ionosphere itself produces electromagnetic radiation in the low frequency range.

The relative strength of the Sun and Earth's magnetic fields also modulates the influx of galactic cosmic rays, which changes climate through cloud formation, and acts directly on the evolution of living organisms over longer periods of time. It has also been documented that subtle fluctuations in the Earth's magnetic field, in part induced by its interactions with the Sun, directly influence the behavior and vital activity of living organisms and is likely a factor in their evolution. But, it is life itself which produced the ionosphere, through its creation of the atmosphere.

Several recent studies also point to the possibility of life's direct role in the creation of the geomagnetic field, possibly through the movement of ocean currents, and through the influence of water on plate tectonics, which could affect heat convection of the hypothesized dynamo beneath the Earth's crust. Whether this is the actual mechanism or not, it is in fact the case that the peculiar character of Earth's magnetic field is associated with its uniqueness as a bearer of living matter in the Solar System. Thus, in sum, it is safe to say that weather, in space and on Earth, is a product of living processes.

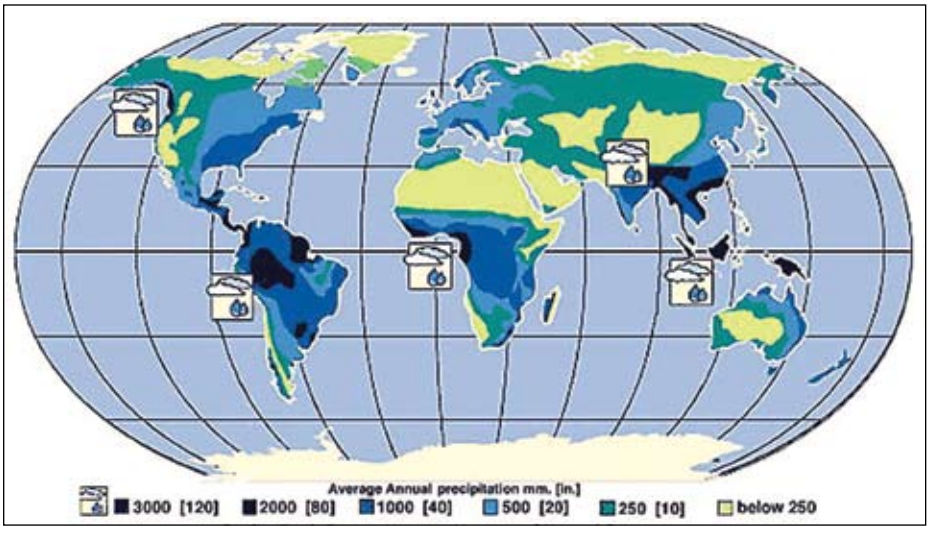


Figure 4
GLOBAL AVERAGE ANNUAL PRECIPITATION

Average annual precipitation, in millimeters and inches, for the world. Note the disparity in the amount of rainfall along the U.S. Pacific Coast.

Source: Earth Forum, Houston Museum of Natural Sciences

radiation and other electromagnetic and gravitational phenomena, in the maintenance and evolution of life on Earth, will be required for the establishment of permanent settlements on the Moon, Mars, and beyond. Projects like NAWAPA will bring such goals—necessary for the continued survival of the human species—out of the realm of science fiction, and within reach of humankind.

The introduction of irrigation, and the consequent agricultural development, increases the amount of transpiration in a given area, creating more sustained sub-cycles of rainfall, and generating rainfall which previously may not have existed.

What Does This Mean for NAWAPA?

In this case, we are taking a portion of the hydrological cycle involving the western region of North America, which currently includes relatively few sub-cycles, and connecting it into a Noöspheric system of much greater complexity. Water that evaporates off the surface of the Pacific Ocean tends preferentially to travel up the coastline as cloud cover, and deposit itself in northern regions as solid ice and rivers.

A large percentage of this freshwater then runs directly into the ocean off the coast of Alaska and North America, never taking part in any biospheric sub-cycles on land. Meanwhile, the southern desert area of the west—the Great American Desert—remains dry and barren (see NASA animation of clouds circulating up the coast at: http://svs.gsfc.nasa.gov/vis/a000000/ a003600/ a003645/index.html).

To get an idea of this quantitatively:

The total amount of water evapotranspired from land and ocean amounts to 57,600 and 351,400 million acre feet per year (MAFY: the amount of water contained on 1 million acres of land, at a depth of 1 foot), respectively,[5] for a total of 409,000 MAFy.[6] Twenty-five percent of that, or 86,700 MAFY,[7] falls back onto the land as rain or snowfall, while the rest is rained directly back into the ocean. At any given moment, there are 12,600 MAF of water in the at-

5. 71,000 km³/yr and 434,000 km³/yr, respectively.

6. 505,000 km³/yr

7. 107,000 km³/yr

NASA

Maintaining crews in space requires the re-creation of parts of the Earth's oxygen, carbon, and water cycles. Here, a group portrait of the crew of the space shuttle STS-131 and Expedition 23, April 16, 2010, in the Kibo laboratory of the International Space Station, while the space shuttle Discovery was docked at the station.

Doug Wilson/USDA-ARS

Center-pivot sprinklers, controlled by a central computer, irrigate wheat, alfalfa, potatoes, and melons along the Columbia River near Hermiston, Oregon. Irrigated agriculture in present desert areas via NAWAPA will increases the amount of transpiration and generate new rainfall.

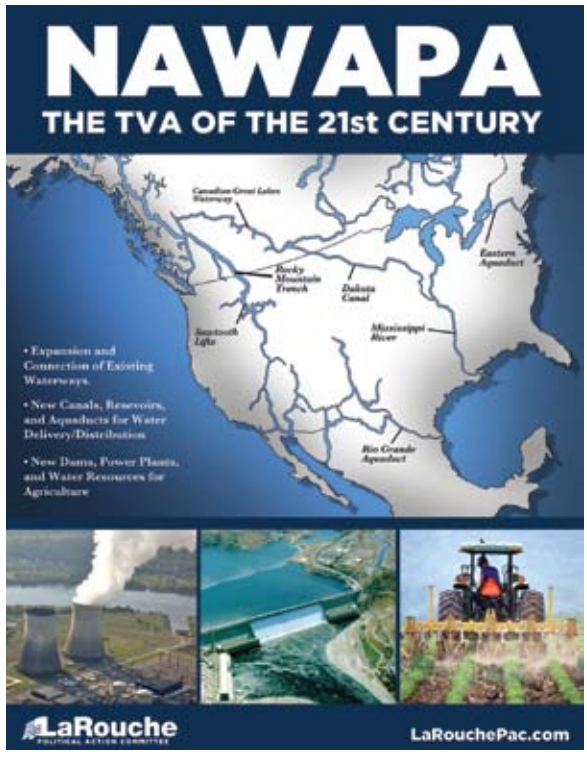


Figure 5
NAWAPA: THE TVA OF THE 21st CENTURY

The North American Water and Power Alliance (NAWAPA) is a continental development project, proposed by the Ralph M. Parsons Company in 1964. Its implementation would have marked a new phase in the evolution of the Biosphere and Noösphere. The failure to implement it coincided with the beginning of a decades-long collapse of infrastructure and physical productivity worldwide, which now threatens the very existence of human civilization.

Source: LPAC

mosphere, 3,600 of which is over land. Approximately 2,800 MAFY fall within just the Alaskan and Canadian catchment basin to be utilized by NAWAPA, an amount equivalent to more than half the total precipitation of the entire continental United States! This produces 800-900 MAFY[8] of runoff into the Pacific and Arctic Oceans. This quantity is lost to the productive processes of the Biosphere, never taking part in photosynthesis, or any other biospheric process during its time on land. This is a continuous cycle, constantly replenished, although, in parts, it is terribly inefficient.

Thus, it becomes clear that, contrary to popular misconceptions and outright lies, the water to be used by NAWAPA is not some stash, which will be run down over time, nor is it water which otherwise would be used for other purposes. NAWAPA is the harnessing and improvement of this natural, global cycle and, because of this, will be capable of not only providing freshwater to the western U.S. and northern Mexico for perpetuity; experience has shown that it will also permanently transform the climate in these areas as a result, lowering the temperature and increasing rainfall.

NAWAPA will transform this cycle, drawing a portion (160 MAFY, or 20 percent) of what would otherwise immediately become run-off water, into a system of already existing rivers and newly made canals. As it travels, the water will replenish groundwater stores and take part in greening large swaths of the Great American Desert. This will extend the time this water spends on land by orders of magnitude, as well as increasing the frequency of its circulation during that stay.[9]

Now, what will be the effect of the increased plant transpira-

8. 990-1,110 km^3/yr

9. It is important to note that here, again, it becomes clear that the concept of a "water cycle" is inadequate. Water which participates in photosynthesis ceases to be water, and is, instead, broken up into free oxygen, released as a gas, and hydrogen, which is fixed into organic molecules, thus feeding into two entirely different "cycles." Thus, although the overall quantity of water on the Earth may stay the same, it is not the case that this is always the "same" water.

California's Central Valley and NAWAPA

In California, some of the country's most productive agricultural land (not to mention America's second largest metropolitan area) is spread over what amounts to a desert. This is made possible by a massive infrastructure network which diverts the flow of the Colorado River and northern Sierra Nevada mountain runoff through a series of dams, reservoirs, pumps, and canals, for delivery of freshwater into the arid central and southern regions of the state.

At the time it was initiated by Franklin Roosevelt in the 1930s, the Central Valley Project (CVP) was biospheric engineering on a grand scale, which was expanded beginning in the late 1950s under California Governor Pat Brown's State Water Project (SWP) initiative.

California Department of Water Resources

Channels in the Sacramento-San Joaquin river delta wind through California's Central Valley. NAWAPA would more than double the amount of water that the present Central Valley systems provide.

A recent study showed that irrigation in the arid Central Valley has led to a decline in average daytime temperatures between 2°-3°C. Today, the CVP and the SWP together provide an average of 10 million acre-feet/yr (12 km^3/yr), representing more than 25 percent of the state's total freshwater consumption. California's yearly share of NAWAPA water would more than double this amount.

tion in the 21-50 million acres of new farmland and forests created as a result of the NAWAPA project? This will be up to double the current irrigable acreage west of the Mississippi. For the United States, this amounts to a strip of newly irrigable land 1,800 miles long and 35 miles wide—nearly four times the size of California's Central Valley.

Again, the careful selection of regions of farmland, but also areas of new, highly organized and maintained forests, where once there was desert, will increase the overall soil moisture, as well as increasing the amount of overall evapotranspiration over land. This will lead to increased rainfall, and, if carefully structured, new and beneficial downwind rain and weather patterns. The water introduced by NAWAPA will be used not once, but multiple times, as it makes its way through innumer-

Aerial view of solar power plants operated by Solar Energy Generating Systems (SEGS) at Mojave Desert, California. Green plants will be more efficient.

Chlorophyll

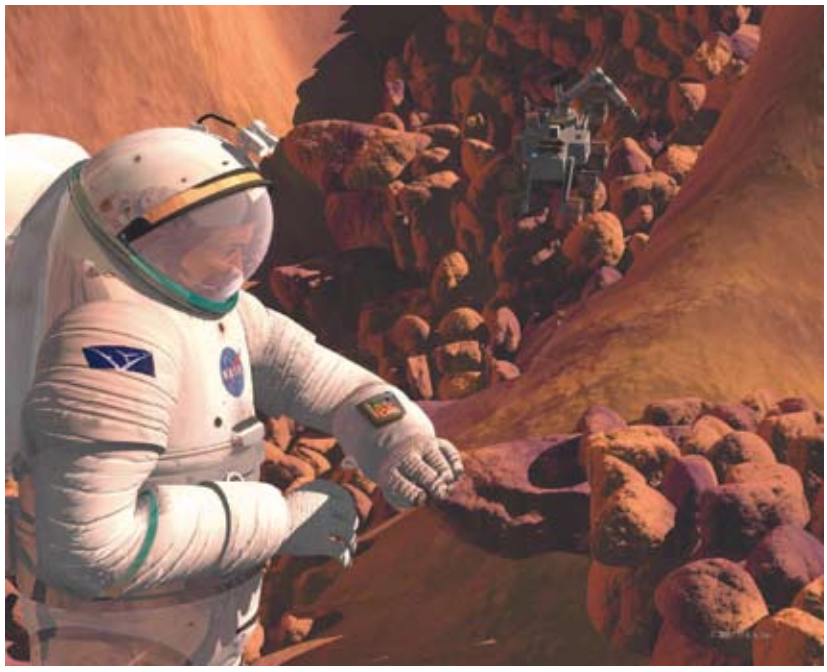
As an aside, it ought to be clear from what has been said so far, that because of the centrality of photosynthesis in this process, land which might otherwise be wasted on inefficient solar panels ought instead to be used to grow green plants—the only efficient utilizers of solar radiation. These massive areas of new greenery, carefully selected as to quantity, quality, and location, will fuel the process of transformation, and beautify the hundreds of new cities which will be built to maintain this process.

The Moon-Mars Project

Understanding the biosphere includes understanding the intimately connected set of relationships among terrestrial and cosmic phenomena, such as gravitation, the geomagnetic field, solar radiation, and cosmic radiation.

On Mars, the magnitude and state of these various elements are very different. For example, the gravitational effect is one third that of the Earth and the magnetic field is faint and dispersed, which, along with other factors, figures in the absence of a substantial atmosphere on Mars, all of which are part of Mars's different dynamic relationship with the Sun itself.

Thus, many factors which we heretofore have taken for granted on Earth, become existential challenges when orienting towards sustaining life on Mars—not to mention the first step in that process of colonization: that of the industrialization of Earth's Moon. This must be done for the purpose, of, among other things, utilizing the low gravity environment for building the ships to take us to Mars, as well as for mining the helium-3, abundant in the lunar soil, to be used as the fuel for the yet-to-be developed fusion-powered rockets, the only fuel capable of achieving one-Earth-gravity equivalent acceleration—an acceleration requirement necessary to deliver humans to Mars in a timely (4-7 days) and safe manner.



NASA

Artist's depiction of an astronaut collecting samples on a future mission to Mars. We will need fusion propulsion for man to make the trip to Mars safely and speedily.

Consequently, in understanding how we come to gain mastery over the organization of Earth's biosphere, we gain insight into exactly what parameters and requirements are necessary to create superior life-supporting systems beyond it.

able smaller sub-cycles, falling multiple times as rainfall over land, before finally making its way back to the sea, to someday, eventually, make its way back to Alaska to begin the entire cycle once again. Only now, among its activities, will be included a plethora of industrial and other uses. This same water might someday be the freshwater used to hydrate the first manned crew traveling to Mars!

A Complex System of Interweaving Cycles

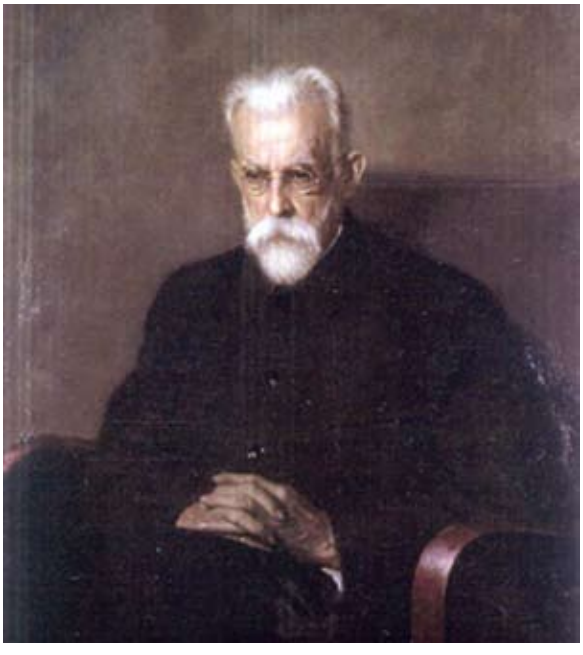
In this way, NAWAPA can be seen as a transformation of a complex system of interweaving cycles, increasing the complexity and efficiency of the overall process, while not subtracting anything. Self-conscious use of the new hydrological subcycles will permit transformations of the several other cycles mentioned above. The increase of the forested area of North America will produce a larger, more efficient CO_2 sink, increasing the rate of the carbon cycle on land. We may even discover that the available CO_2 is too little for our purposes! To fuel that carbon cycling, we will need to—among other things—increase the amount of available nitrogen in the soils, allowing for the growth of these photosynthesizing plants.

The available water will be used to replenish groundwater stores such as the Ogallala Aquifer, reduce the mineral contamination of water retrieved from the Colorado River, and clean the soil of farmland in the Midwest, as well as flushing and replenishing the Great Lakes. This same process will be the model for the similar development projects to be deployed in Mexico, Africa, Central Asia, Southwest Asia, Siberia, Australia, and similar regions worldwide, thus further extending man's conscious management of the Biosphere as a whole. Afterwards, this process can and must be extended to include more directly the development of Earth's oceans.

It is significant to note that, despite the seemingly colossal scale of all of this, we are discussing relatively tiny portions of incredibly large numbers. Only about 1/billionth of the radiant energy released by our Sun falls on the Earth, at any given moment. Not more than 50 percent of this tiny bit of radiation fuels the processes of evaporation, transpiration, and photosynthesis, which latter drives the biogenic migration of atoms, producing—among all of the other things we have discussed—all of the rainfall and all of the flow in the rivers we are here discussing. In order to accomplish NAWAPA's goals, only about 20

percent of the runoff from the targetted Alaskan and Canadian rivers is required to be redirected. This runoff represents perhaps 1 percent of the total runoff of the Earth's crust, which itself is a small percentage of the total freshwater, 70 percent of which is locked up in snow or ice.

At any given moment, only about 1 percent of the total freshwater of the planet is "in play" in the near-surface Biosphere—only 1 percent of freshwater is directly accessible to living processes at or near the surface of the planet. But what occurs in that 1 percent drives the entire cycle, much in the same way as living matter—a tiny percentage of all of the matter in the Biosphere—drives the entire biogenic migration of atoms, reshaping Earth's crust and oceans, creating Earth's atmosphere, and governing the electromagnetic interaction with the universe as a whole. Man, in terms of his mass, represents a tiny portion of even this tiny amount of living matter. Yet man, by the power of his mind, is the only force in the universe deserving of the title "Co-Creator" of that universe—capable of understanding and improving the processes by which that universe was brought into being.



V.I. Vernadsky (1863-1945)

Vernadsky and the Biosphere

Vladimir I. Vernadsky's concept of the Biosphere contained nothing of the silly "equilibrium" that modern environmentalist idiots seek to ascribe to it. Rather, it was a dynamic and evolving system which formed the interface between the Earth and the energetic processes of interplanetary and interstellar space. The introduction of man shifted that dynamic system into a new state—that of the Noösphere—providing for levels of creative evolutionary development which were otherwise impossible, including the possibility of greening the deserts, and extending the Biosphere beyond Earth's surface. This scientific understanding of nature—as opposed to the primitive, superstitious notions pushed by the anti-human "green" movement—is indispensable for a true science of economics.

The Necessary Next Step

In this way it should become clear that NAWAPA is not merely a piece of interesting policy. It is the necessary next step in man's emergence from his civilizational adolescence. In order to accomplish this next step, a major cultural-political shift must occur, which will express the sharp rejection of the cultural and political turns of the last decades. NAWAPA alone will be a multi-generational project, requiring at least a quarter of a century for its completion. The expanded mission of developing the Solar System will require several generations more. This is the antidote to the no-future ennui of today's young adult generation, forging the cross-generation connection which separates our species—at its best moments—from the beasts.

Like all great feats of human creativity, this is not a project designed for immediate consumption. This is a project designed to extend man's sense of self far beyond the confines of his sense perceptions and feelings of personal well-being, and connect him instead to generations which will continue his legacy long after his generation has left this Earth.

The cultural transformation required to accomplish a project of this scale, must include a repudiation of the past decades' policies of free trade, and a reinstatement of the kinds of controls over banking and financial policy which the Glass-Steagall standard represents. We must see a clear rejection of the anti-science, anti-progress, and anti-human policy represented by the recent decades' rise of green fascism.

Most important, we must demand the rejection of this current President, Obama, whose personal sense of identity, like his policies, lies in those very same failed cultural characteristics which have brought us to this point of collapse. Then, and only then, may we free ourselves for the real work to be done.

The authors are members of the LaRouche Youth Movement basement research team. This article first appeared in the Executive Intelligence Review*, Aug. 13, 2010.*

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Aletsch Glacier, the largest glacier of the Alps, in Switzerland.

Climate Change Since the Little Ice Age

by Dr. Horst Malberg

Prof. Horst Malberg, a retired professor of meteorology and climatology, gave this presentation at the industrial policy conference held by the German political party BüSo (Civil Rights Solidarity Movement) on March 20, 2010, in Bad Salzuflen. It was translated from German by Vyron Lymberopoulos, and subheads have been added.

Dear ladies and gentlemen: I'm happy to speak to you today, and I promise you I will not speak on questions of faith. I leave that to others. You know, climate change has become a substitute religion, and I am only going to speak about my own results, those which I can also prove.

About myself: For decades I was a professor of meteorology and climatology, and director of the well-known Meteorological Institute at the Free University of Berlin. I have been retired for some years and am no lon-

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German Chancellor Angela Merkel visiting the Eqi glacier in Greenland in 2007.

ger accountable to anyone. I always say that the only two things standing over me are the love of God, and my spouse. And because neither objects to my theses, I will tell you something about my research.

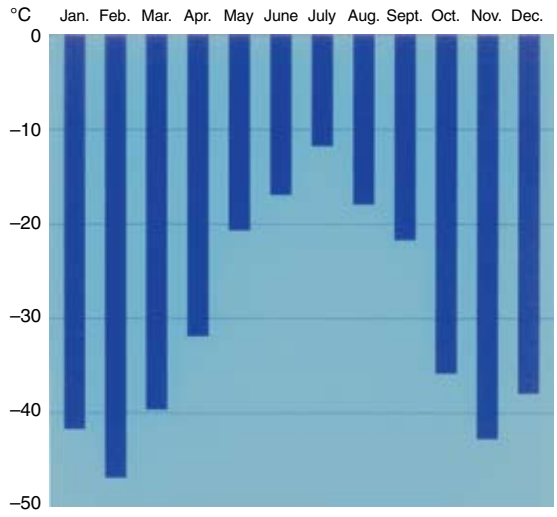
Basically, you are all climate experts. The media, newspapers, television, radio, blast the climate theme at your ears, and along with it many things that are simply false.

Retreat of Glaciers?

The first topic, I would like to talk about is the thesis of glacial retreat. The hoopla on the Himalayan Glacier—you heard about this—is that by the year 2035, all the ice would have melted. But then it was found to have been a "misprint" by a rogue source; it was supposed to be 2350, not in 30 years but in three centuries. You remember that Madame Chancellor Angela Merkel and Environment Minister Sigmar Gabriel proudly had a photo taken of them on the Greenland glacier. For now we have a temperature rise, as we will see shortly, of nearly 1

Photograph of Ötzi the Iceman, shortly after the discovery of the body in September 1991, when it was still frozen in the glacier and had not yet been removed. Five thousand years ago, when this Iceman lived, the glacier ice front was farther up than it is now.

Figure 1
MEAN MONTHLY TEMPERATURES OVER GREENLAND ICE



degree. And as a consequence, the ablation of glaciers should start now.

What you see in Figure 1 are temperatures of the Greenland ice—not below at the coastline, where the sea current plays a role, but higher up on the ice, and also when it is hard to see. When you look at the scale, it starts at zero, and over Greenland it naturally goes farther still in the minus range. We can determine that in Winter we have temperatures between –40°C and –45°C, and in Summer about –15°C. And now we have global warming of +2°C. In other words, in the Greenland wintertime, we have temperatures of –38°C and in Summer –12°C.

You see, you have answered the first question with your laughter. Which glacier is melting? Death by laughter! I have always asked my students before graduation: What happens if the temperature rises by 1 degree celsius? The right answer was: "There will be a shift in the snow line—that is, the transition from rain to snowfall—by 1 degree, 150 meters upwards on the map, no more."

Now, when you look at the glaciers of the Alps, the snow line rises gradually: 150 meters in the vertical. In other words, when the temperature rises, the glacier ice front withdraws at the bottom, not at the top. It withdraws at the ice front.

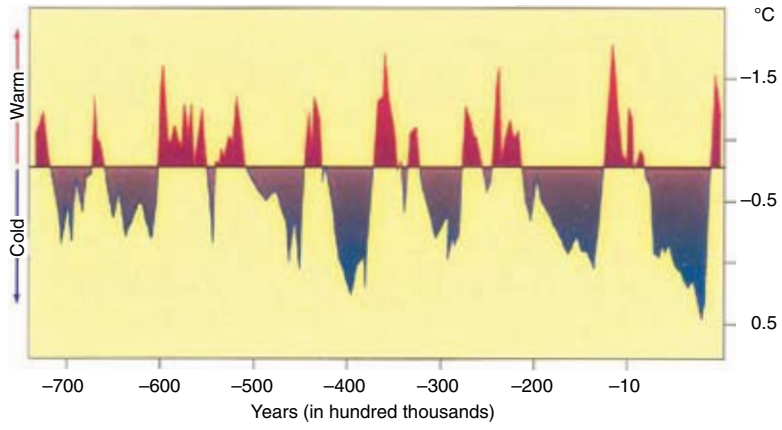
And what is revealed, after the glacier has withdrawn its glacier ice over the last 100 years? Suddenly, tree trunks appear, Ötzi the 5,000-year old iceman appeared again. In other words, at one time the ice front was withdrawn farther then the present day.

And how could the vegetation have developed below the ice? When the glacier withdraws, it is also a very good indication of the climate. On top, primarily nothing happens, at least with normal climate relationships. Why is it that the glacier also melts higher up? Somewhere on television, I saw a mountain guide make this point. He said: The glacier is sweating in the Sun and melts. The parts situated in the shade don't melt.

In other words, solar radiation is the core of the problem, not the puny temperature rise of 1 degree C. And what has hap-

pened? By industrialization, over the last 100-150 years, the glaciers have become "dirty." A dust layer has formed, little by little. And we all know that a darker body absorbs solar radiation much better than a lighter one. The glacier has lost its natural potential of reflection, and now it sweats and melts, also higher up. This has nothing to do with global climate change.

Figure 2
CLIMATE CHANGE DURING THE LAST 750,000 YEARS:



More Extreme Extra tropical Storms?

The second fairy tale thrown at you, after we had the windstorm Kyrill in January 2007, is that, in the future, we have to become used to such extreme storms. I have asked my students, please explain why wind storms never occur during Summer. Surely we have small storm fronts, but no wind storms of many hundred kilometers; they only occur during Winter. Students who have somewhat mastered cyclone theory knew the answer right away: Wind storms arise only when the polar region is very cold. That means, when the temperature difference between the subtropics, the Azores High, and the polar region should be large. During Winter, the difference in temperature is 45° to 50° C; during Summer, it is approximately 20° to 25° C. In other words, conditions for the genesis of wind storms are worse when the meridianal temperature difference decreases.

According to global warming theory, the greenhouse theory, the polar region warming should be two times stronger compared to the subtropics. Consequently, few Kyrills will appear, not more. More is both physically and meteorologically impossible. You have been told old wives' tales.

Switch between Interglacial and Ice Ages

What you see in Figure 2 are the Ice Ages, for the last 700,000 years of climatic development. Everything below the horizontal line, pointing down, are the cold periods that led to the Ice Ages, and everything pointing up, above the line, are the interglacial periods. What do we see? First, there is a regular pattern of a switch between Interglacial and Ice Ages. Furthermore, we see, that in general, from the Interglacial to the next Ice Age took really a long time, but from the Ice Age to the next Interglacial there are just some thousands of years. So this change is very fast.

The last Ice Age is approximately 10,000 to 15,000 years behind us; in other words, the climate has recovered really quickly. Above all, we see that permanent climate change is entirely usual. It is absurd to believe that a stable climate is the usual. Natural climate change is normal.

When you look at the figure, you can note that between two Ice Ages, or analogously between two interglacials, there are on average about 100,000 years. Now we are, let's say, 20,000 years after the last Ice Age. Therewith, my first prediction: In about 80,000 years, we will have the coldest part of the next Ice Age, if we live to see it.

Also note that after the Ice Age, our climate has changed permanently. You see, here (Figure 3) is our region, Germany, after

The Kyrill windstorm in January 2007 felled power pylons and caused massive electricity outages in Europe. It is a myth that "global warming" will cause more such storms.

Figure 3
CLIMATE CHANGE IN MIDDLE EUROPE AFTER THE LAST ICE AGE
(15,000 years before the present)

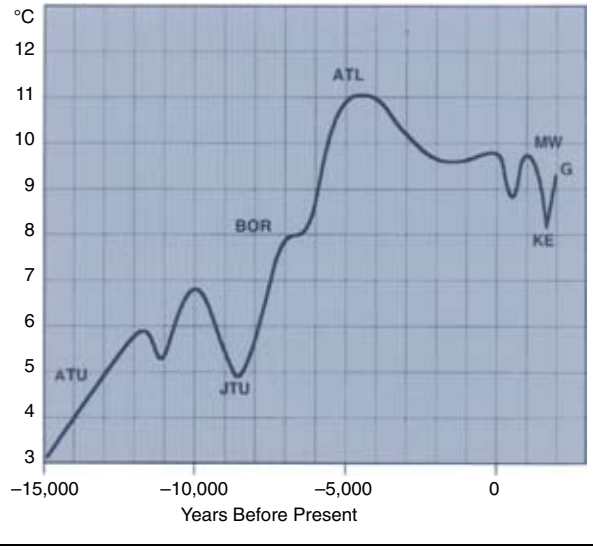


Figure 4 (a)
YEARLY MEAN TEMPERATURE DEVIATIONS SINCE 1850: GLOBAL

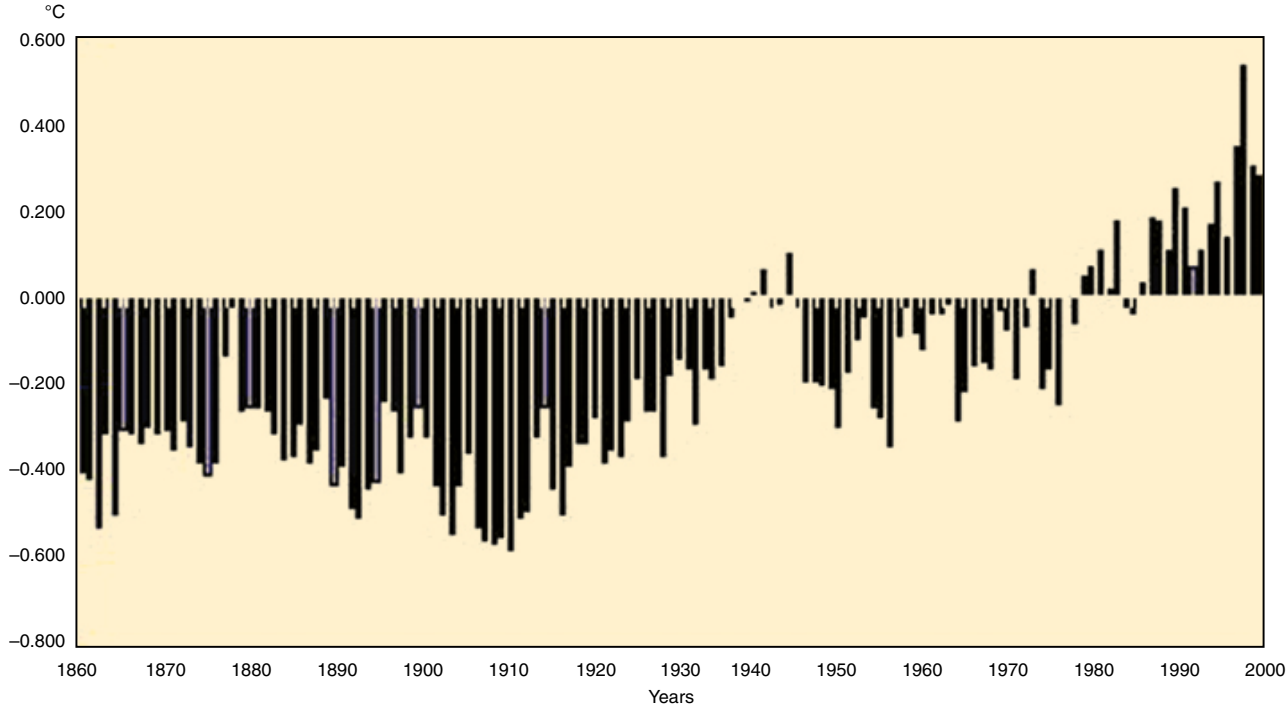


Figure 4 (b)
YEARLY MEAN TEMPERATURE DEVIATIONS SINCE 1850: NORTHERN HEMISPHERE

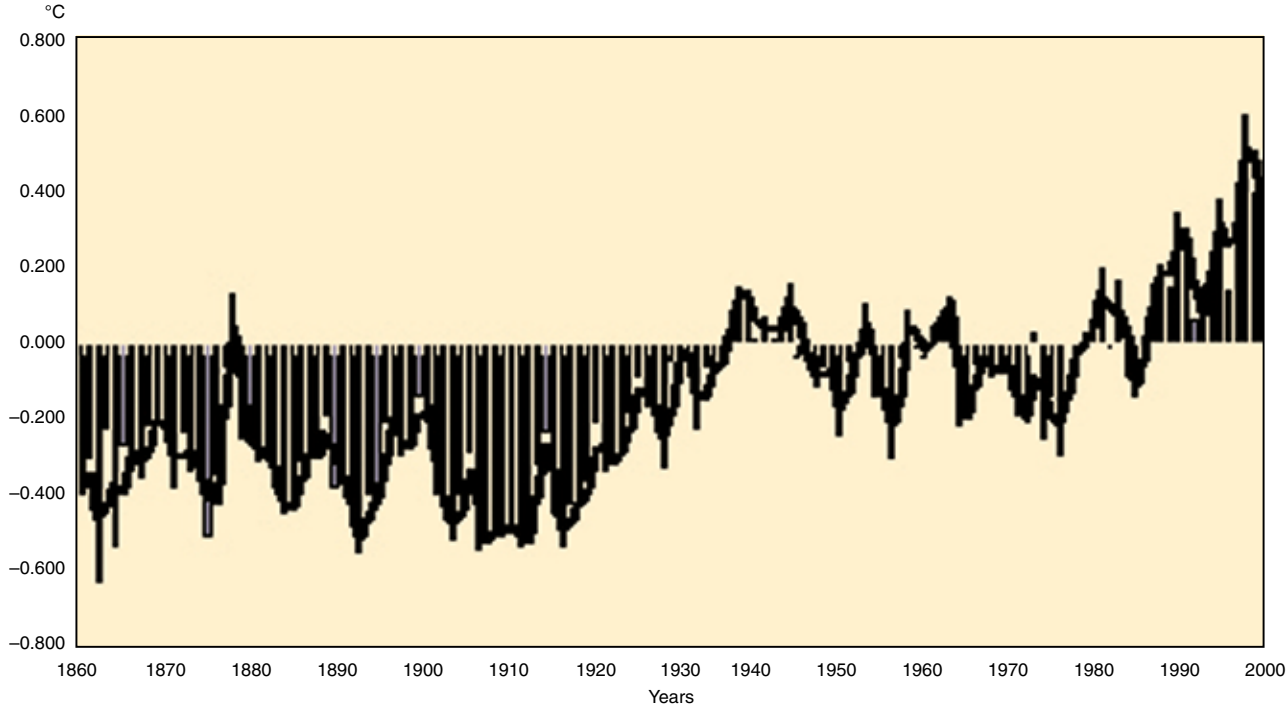
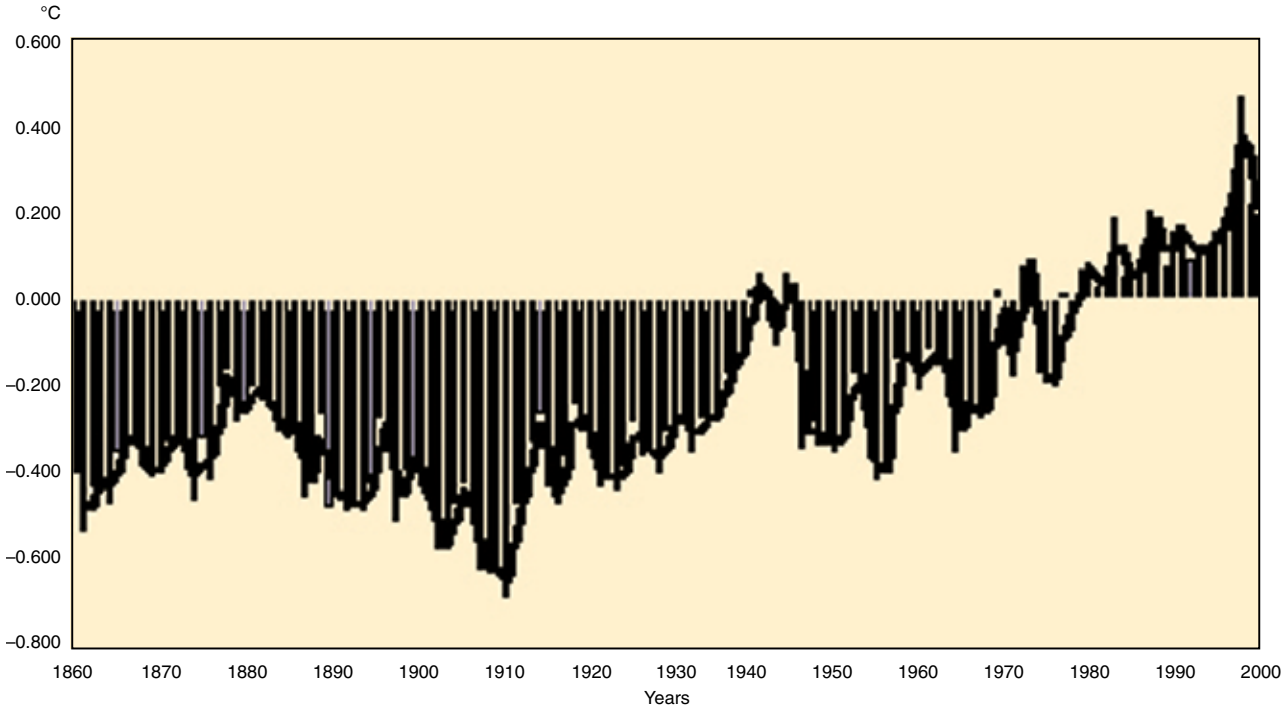


Figure 4 (c)
YEARLY MEAN TEMPERATURE DEVIATIONS SINCE 1850: SOUTHERN HEMISPHERE



the last Ice Age, when the ice has withdrawn. We used to have climatic conditions like the tundra of Lapland, northern Siberia, or northern Canada, with the accompanying vegetation relationships. Then temperatures curved upwards. Here, at 5,000 to 6,000 B.C., for example, it was warmer in Europe than today. It goes on, up and down, and finally we arrive here at the end, in the present.

This shows that climate change is something very natural and, very important, that there have to be many factors, some main factors at least, that govern our climate and that permanently change the climate.

Global Warming Since 1850

The very wild climate discussion we have today, began when some of my British colleagues started out primarily to collect data from climate observations, and then developed climate graphs for the Northern and Southern hemispheres (Figure 4). You see, for the global, the Northern and Southern hemispheres, identical trends. And notwithstanding these many, many data points, we have to discern between long-term climatic development, and that which happens from year to year, or from decade to decade.

The year-to-year variations are weather anomalies, which have nothing to do with climate. One year does not play a significant role, and also, it has nothing to do with CO_2 but everything to do with the warming of El Niño or the cooling of La Niña in the tropical Pacific between South America and Australia.

What we see in Figure 4 is that in general, there is a trend upwards. And that is unchallenged; it's the warming that has taken place since the year 1850. The important question when one sees such warming trends, is "What is the cause?" And

Figure 5
INCREASE OF CO_2 (1850-2000)

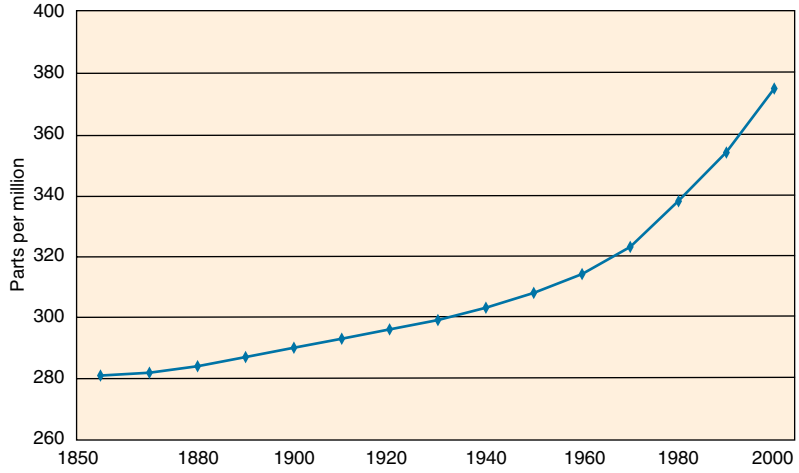
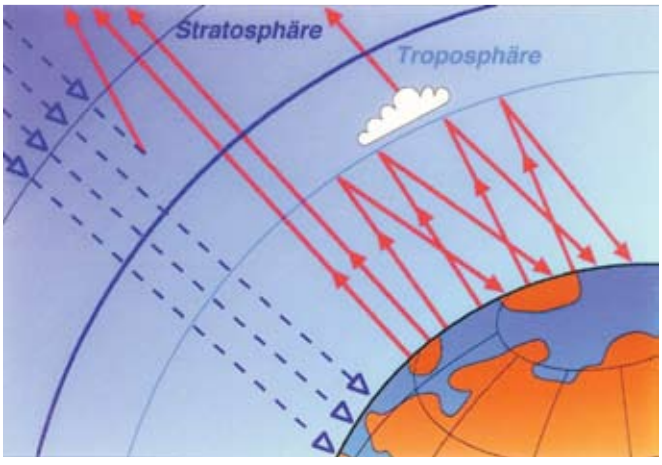


Figure 6
SCHEMATIC OF THE GREENHOUSE EFFECT



here we have a factional split.

One group of scientists say that the influence of the Sun cannot explain the global warming since 1850, and that there has to be another magnitude which has changed the climate. These people came up with CO_2 emissions as the cause for the global warming since 1850. In Figure 5, you can see how the CO_2 content in the air has increased from roughly 280 parts per million to 380 units. And you see further that the CO_2 content in the air rises steadily; there are no variations up or down; it just increases.

Then the first climate models were made, and in these models, nature no longer played an important role. The rise in CO_2 content, what humans are doing, became the primary climate forcing. Everything that has been thrown at you, all the calculations, come from that assumption. The result: There is warming of 2 degrees C, or there is warming by 6 degrees in the next 100 years.

Scenarios But No Predictions

You are not told that these are not predictions. It just appears as though they are. With predictions, I know exactly all the conditions that have an impact, and I know all the atmospheric reactions. But can you know how many Chinese will drive to the mall with which car 30 years from now? Nobody knows. Or do we know how global cloudiness will increase and cool the Earth, when it gets warmer? That implies that a great many assumptions are inserted into these global calculations, and how the assumptions are inserted will influence the outcome.

And that is the problem. What we get are scenario calculations. They are not predictions, although they are presented as if they were predictions. Scenarios mean that the results will depend on the assumptions. They are computer games.

The Greenhouse Effect

All these climate scenarios are based on the greenhouse effect. And now, just briefly, what is that ominous greenhouse effect that everybody talks about? What you see in Figure 6, the dashed line, is incoming solar radiation. The solar radiation reaches Earth and heats the surface. We know that between day and night, there is a warming of approximately 10-15 degrees C, depending on the amount of clouds, and on whether it is Summer or Winter. The Earth's surface is warm now, and gives off warmth to the air layers above.

This heat radiation—infrared radiation—arrives in the atmosphere and is partly absorbed by the droplets and ice crystals of the clouds. These clouds radiate this absorbed heat partly back to Earth. You are all familiar with the fact that a clear night, without clouds, is colder than a cloudy night. So, when we have clouds, emitted warmth partly returns to Earth. The same process basically occurs with the molecules of greenhouse gases.

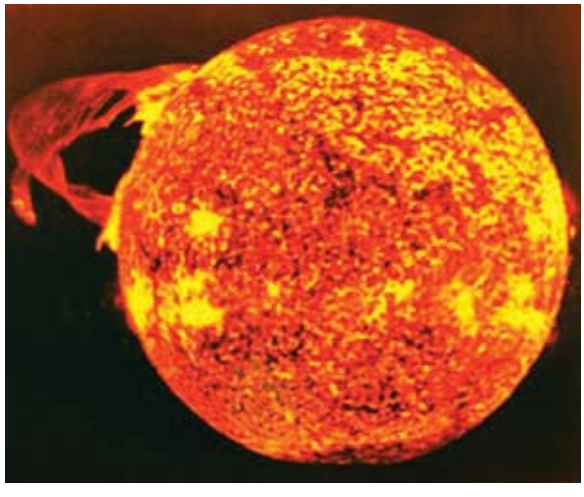
The fundamental question is, which portion of the warmth can be absorbed by atmospheric gases—particularly the damned CO_2, but also methane, nitric oxide—and partly returned to Earth. In the climate models it is assumed that the anthropogenic greenhouse effect is so strong that natural climate factors play no essential role in the recent global warming. This is the theory, which is extremely controversial.

Significance of Sunspots

Next, let's look at the Sun. Here, in Figure 7, you see the Sun and many dark spots on the Sun, and enormous eruptions of plasma on the surface, where the Sun hurls large amounts of energy into space. The dark "freckles" on the Sun are called sunspots. Ever since Galileo and Kepler discovered telescopes, since about 1600, sunspots have been observed, and by now man knows, or has known for a long time, that the core area of these sunspots is approximately 1,000° C cooler then the surrounding area.

The dimensions of these sunspots would stretch from roughly

Figure 7
THE SUN AND SUNSPOTS



1,000 to 10,000 kilometers; in other words, these are huge areas. During my university studies, it was said that it is colder at the Sun when many sunspots occur, and when it is colder at the Sun, it should have less energy and has to be colder. But that belief was a fallacy. Since observations by satellite became possible, we learned that whenever many sunspots occur, the Sun is highly active. When few sunspots occur, then the Sun is quiet, and we call it a quiet Sun. In summary, sunspots are an indicator of the activity of the Sun.

Figure 8 shows the mean yearly number of sunspots. Imagine, if one has freckles, and from year to year, they become more numerous or become less numerous. It is similar with sunspots. In each 11-year sunspot cycle, for about 5 or 6 years, the number of sunspots increases to a maximum, and in the following 5-6 years, it decreases to the minimum. Here you see in Figure 8 how the variations in the number of sunspots form bell curve cycles. But you can also see that the Sun produced less or more sunspots in one cycle compared to others. This means that the Sun has varied its activity from cycle to cycle. When you place a curve over all cycles (Figure 9), you discern that the number of sunspots, calculated for the average number of every solar cycle, has increased since 1850, and so has solar activity.

One of the many cold winters of the Little Ice Age is depicted here by the Flemish painter Pieter Bruegel the Elder (1525-1569).

And now we arrive, after these previews, to the question of climate change. Here in Figure 10, you see the global temperature. In 1850, the temperature was relatively low, and since then it has risen gradually. There is an unmistakable in-

Figure 8
YEARLY MEAN NUMBERS OF SUNSPOTS AND SUNSPOT CYCLES (1900-2009)

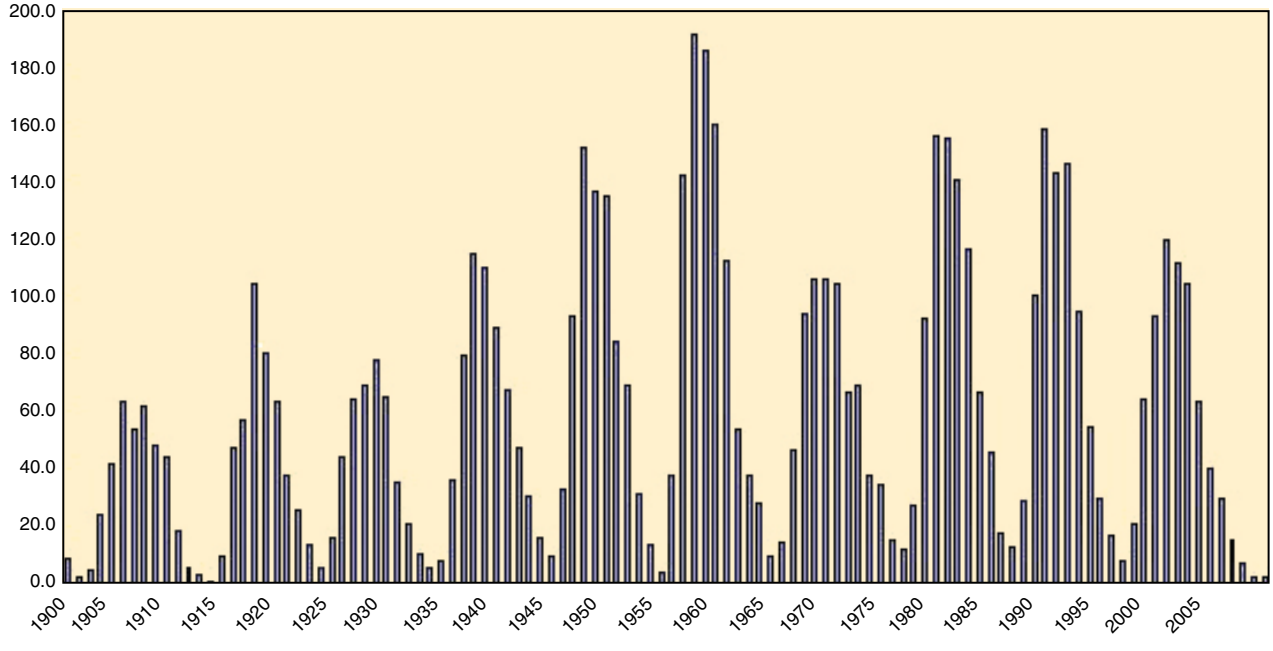


Figure 9
MEAN NUMBER OF SUNSPOTS OF EACH SOLAR CYCLE (1850-1999)

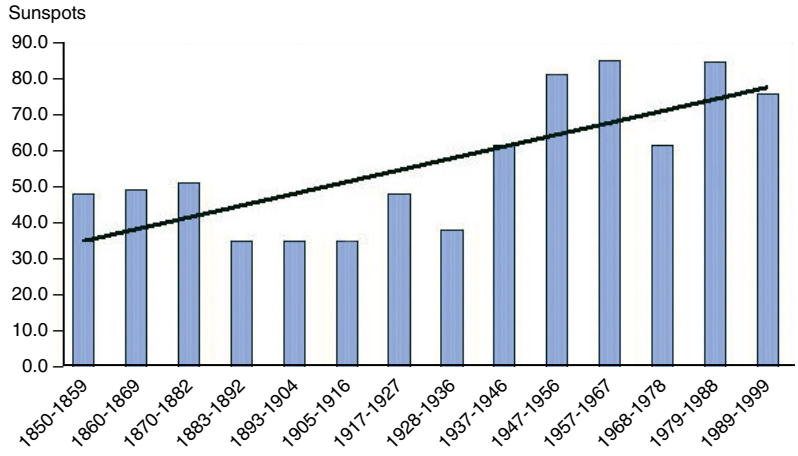


Figure 10
INCREASE OF MEAN GLOBAL TEMPERATURES (1850-1999)

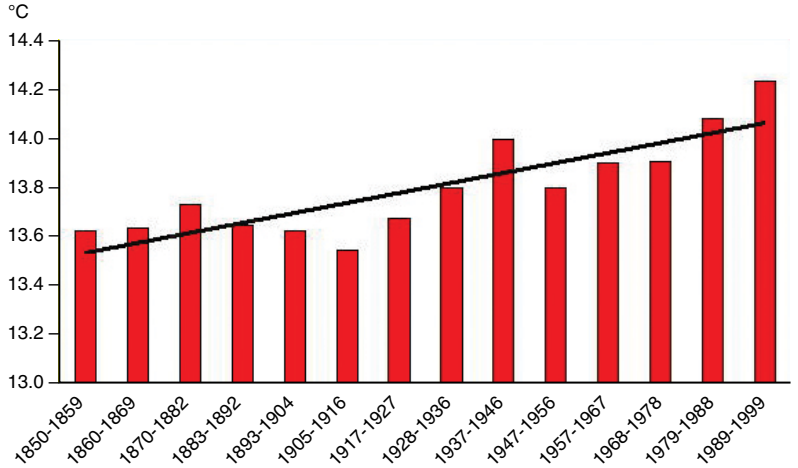
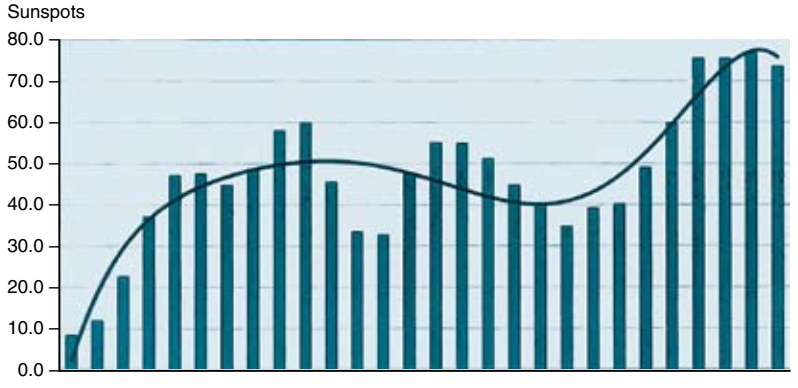


Figure 11
MEAN NUMBERS OF SUNSPOTS FROM 1672-1999



crease in temperature over the last 150 years. No argument there. This is the so-called global warming, approximately 0.6° C.

Now, when we put the two figures (Figures 9 and 10) on top of each other—the global temperature and the sunspots—there is no doubt that both curves run in parallel. So here we clearly have a relationship between the increased solar activity of the last 150 years and global temperature. The global data set is 150 years long. In contrast, there were very good observation posts in Europe, both in Middle Europe (Germany, Austria, Switzerland, and Czechia) and in Western Europe (centered on Great Britain). The European climate data sets give us information about climate changes for more than 300 years.

In Figure 11, you can see the development of temperature for Middle Europe, after the Little Ice Age of the 17th Century. The temperature rose during the 18th Century. Then there is a new break in the 19th Century, and then warming in the 20th Century. The global scale shows us the temperature relationships from 1850, starting in the most hostile period after the Little Ice Age. The global scale is characterized only by temperature rise. It tells us nothing about the climate before 1850. But around that time, in Germany and in Middle Europe, there were dramatic crop failures as a result of the climate relationships. People starved, really starved, which began the large-scale emigration waves to the USA.

In other words, since global warming started, we have been having good fortune, not a climate catastrophe.

Temperature Rise and Sunspots

Figure 12 shows, for the same time scale as Figure 11, the development of the sunspot numbers since 1672. During the Little Ice Age, the sunspot activity was very limited; it decreased in the 19th Century, and increased again in the 20th Century. That means that temperature, as well as solar activity, represents a wave-like, almost sinusoidal function.

When we look at the time elapsed between the minima and maxima of solar activity, it is roughly 200 years. This long solar activity cycle is called the De Vries cycle by astrophysicists. And now a hint: Again with temperature, we see a 200-year oscillation. This means that

since the last Little Ice Age, during which time we have observational data, our climate has always been coupled to solar activity.

To stress the relationship between solar activity and climate, we will consider their anomalies. We are accustomed to say a month or a year is warmer or colder than normal. That means, in our case, we calculate average values for sunspot numbers and temperature for the period 1672-1999. In Figure 13, we see the deviations of sunspot numbers from the average; in Figure 14, the deviations of temperature from the average.

Now let's discuss the graphs. We can see in Figure 14 that it was cooler (below average) during the Little Ice Age, and that the 18th Century was warmer then usual. Again, the temperatures were below average during the 19th Century, and then again became warmer than usual. What you can simply recognize here is that it is the same 200-year oscillation as mentioned before. In Figure 13, we see that the anomalies (deviations from average) of solar activity have exactly the same rhythm as temperature anomalies.

During the Little Ice Age, solar activity is below average. Then it goes up and down, and up again: the same sinusoidal wave. And when we place one curve on top of the others, we can state as a matter of principle: Every time the Sun's activity is below normal, we have a cold period. When the solar activity is above average, we have a warm age.

Now we arrive at my logic in reasoning that it is the solar effect, and not the CO_2 effect, which determines climate change. Qualitatively, the consonance of the temperature and sunspot curves, their synchronous conduct over the last 300 years, is an indisputable fact. For those interested in statistics, quantitatively the result of correlating solar activity (the number of sunspots), and temperature shows a very high relationship. Changes in solar activity explain 70 to 80 percent of the long-term climate behavior of the past centuries. The results indicate a statistical probability of 99.0 to 99.9 percent.

Figure 12
COURSE OF MEAN MIDDLE EUROPE TEMPERATURES FROM 1672-1999

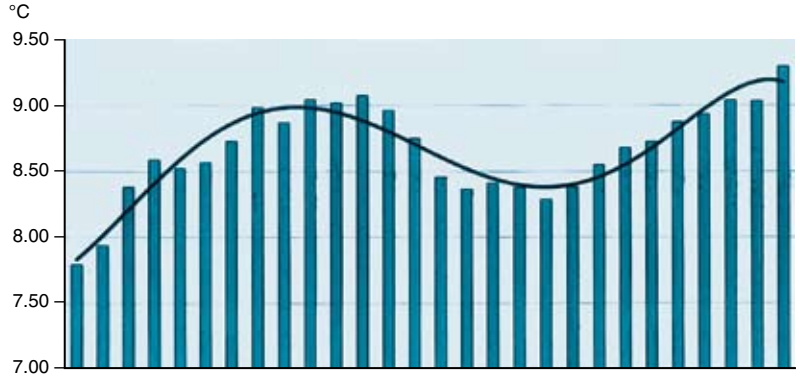


Figure 13
ANOMALIES (DEVIATIONS FROM AVERAGE) OF SUNSPOT NUMBERS 1672-1999

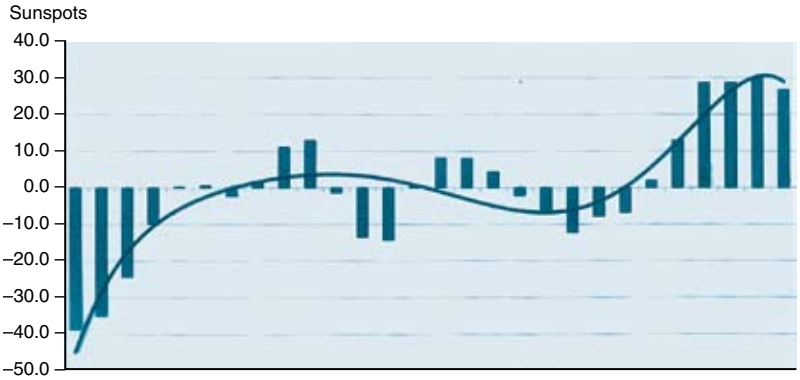
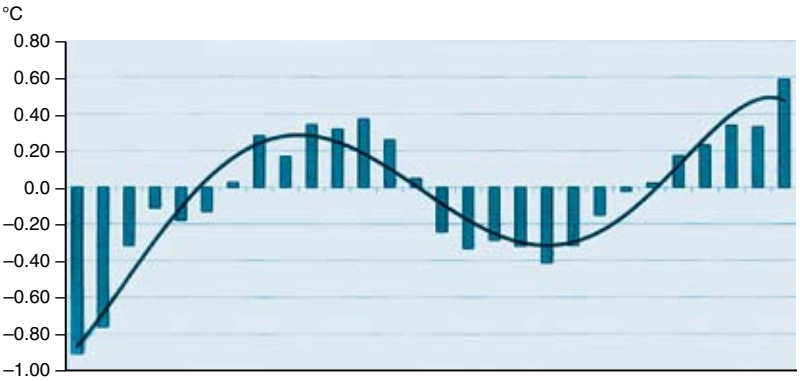


Figure 14
ANOMALIES (DEVIATIONS FROM AVERAGE) OF MIDDLE EUROPEAN MEAN TEMPERATURE 1672-1999



The Future of Climate in The 21st Century

When we look once more at climate development from this standpoint, we see that in the 17th Century it was cold, and in the 19th Century it was cold. In the 18th and 20th centuries it was warm. The change of solar activity was analogous. Based on these near 200-year cycles, we should expect that soon there will be the beginning of a decrease of solar activity, and

the start of global cooling. The forecast based on progressive $C0_2$ warming is therefore most unlikely.

I am not the only one who has arrived at this conclusion. Both the main observatory at St. Petersburg and a research institute in Orlando, Florida, have arrived at these results. They expect a temperature drop soon to reach a low point around 2050, before rising slowly in the 200-year cycle.

From this it follows that measures like the storage of CO_2 and trade in carbon certificates are not proven scientifically, based on actual climate as well as the anthropogenic influence on the climate. Such measures are not proven scientifically and merely represent a squandering of money.

CO_2 is no toxic gas, as claimed by the media. I don't know if you remember your chemistry class. If you do, you will recall that CO_2 is the precursor of oxygen, and we need oxygen to live. But what is producing the oxygen? Plants! A plant takes CO_2 from the air, and H_2O from water, and thereby produces oxygen. In other words, the most important substances for life are CO_2 and H_2O, from which plants produce oxygen.

To talk about CO_2 as a toxic gas that is harmful to the climate is total idiocy.

Finally, a concluding remark: As I see it, every human being has the fundamental right to clean air, clean water in the lakes, rivers, and oceans, and to clean soil. In other words, worldwide there is a fundamental right to optimum environmental protection. There is no fundamental right for a stable climate, and there never was. The stabilization of CO_2 in order to limit the temperature rise to 2 degrees C is scientifically groundless.

EIRNS

"Climate change has become a substitute religion": Prof. Malberg addressing the March 20, 2010 industrial policy conference of the Civil Rights Solidarity Movement in Bad Salzuflen, Germany.

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In Appreciation of Maurice Allais (1911-2010)

The *New Physical Field* of Maurice Allais

by Laurence Hecht

October 24, 2010

Maurice Allais, French polymath and 1988 Nobel laureate in economics, died Oct. 9, 2010. We present here an appreciation of the work in physical sciences by this extraordinary genius, which included groundbreaking experimentation with a paraconical pendulum demonstrating the existence of a new physical field. Professor Allais graduated in 1931 from France's École Polytechnique, first in his class. and later served as an administrator in the Bureau of Mines, professor of economic analysis at the École Nationale Supérieure and research director at France's National Center for Scientific Research, among other responsibilities.

* * *

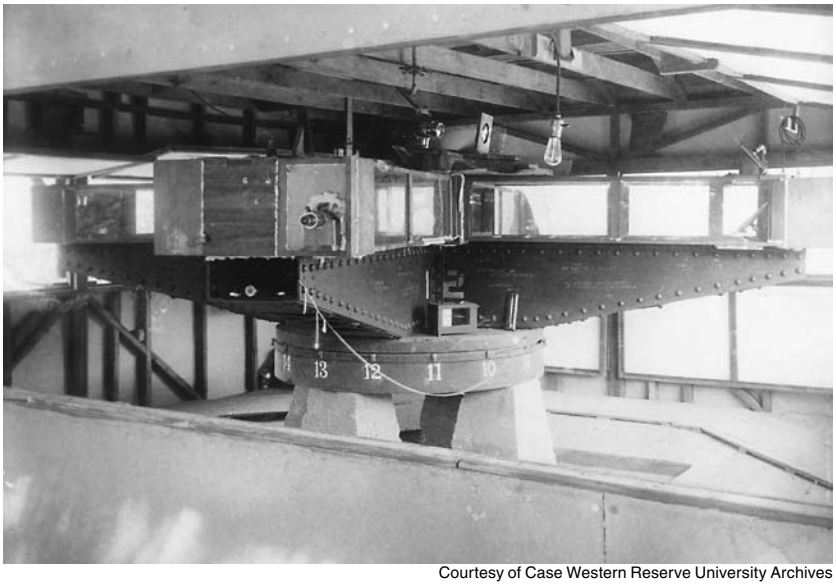
Maurice Allais' physical researches are often viewed as a counter-position to Einstein's relativity theory. Professor Allais indeed presented compelling evidence that the speed of light is not independent of its direction, and that therefore this precept, which is at the foundation of the special and general theory of relativity, renders the theory invalid. That shocking possibility much intrigued me in 1998, when I first learned of the work of this French genius whom I later came to know both as a friend and a source of scientific inspiration. I shall touch only briefly on that aspect of Allais' work here, rather emphasizing his own experimental researches with the pendulum, leading to the identification of a new physical field, which I believe constitutes the most important of his contributions to science.

Studio Harcourt Paris

As Einstein's unique formulation of the relativity of space-time subsumed the existing laws of mechanics in a new and more comprehensive framework, it would only be the discovery of new physical phenomena that could fundamentally undermine this conception. Einstein's 1921 visit to American physicist Dayton C. Miller, and his later published comments on the Mount Wilson experiments, indicated his openness to this possibility. Miller, who had taught at the Case School of Applied Science in Cleveland with Albert Michelson's collaborator, the chemist Edward Morley, was then attempting to demonstrate with an improved apparatus that the Michelson-Morley experiment had not produced a null result, but rather one which was in accord neither with the assumption of Einstein that there was no ether—that is, a medium through which light and other electromagnetic waves propagated—nor with the older view of a stationary ether. Einstein encouraged Miller, noting that if the experimental results should prove him wrong, a new theory would be required. That exchange, and Miller's experiments, played an important part in Allais' thinking. However, that is not the best way to introduce the reader to the significance of his work.

The Paraconical Pendulum

Let us rather go directly to certain experiments with a unique sort of pendulum, conceived in 1953 and carried out by Professor Allais and assistants from 1954 to 1960 in a laboratory in Saint-Germain, and during part of one year simultaneously in a quarry at Bougival, some kilometers distant. The idea for these experiments had come from Allais' conviction that the propagation of the gravitational and electromagnetic actions requires the existence of an intermediate medium. It would not be precisely the ether as conceived by Augustin Fresnel early in the 19th Century, but a modification of it, for this ether could not be motionless in relation to the fixed stars, as had earlier been assumed. A magnetic field, whose geometric expression in the form of a whirl is easily demonstrable, would



Courtesy of Case Western Reserve University Archives

The interferometer used by Dayton Miller between 1924 and 1926 at the Mt. Wilson Observatory in California.

then correspond to a local rotation within this presumed medium, or ether, in Allais' view. And from this thought came his idea for an experiment that could establish a never before observed link between magnetism and gravitation. If the magnetic field represents a local disturbance within the ether, it should produce some subtle effect upon the motion of a non-magnetic body, falling, as does a pendulum, under the influence of gravitation through that magnetic field.

Allais began in 1952 with observations of a glass ball suspended on a thread about 2 meters long, but with no magnetic field other than that of the Earth. "To my great surprise, I found out that this movement did not reduce itself to the Foucault effect, but displayed very significant anomalies in relation to this effect," Allais wrote in an autobiographical essay completed in 1988, the year he won the Nobel Prize in Economic Science.[1]

In 1861, Léon Foucault had famously demonstrated that a long pendulum, mounted so that it was free to swing in any vertical plane, would gradually change the azimuth of its plane of oscillation, turning through a full circle to return to the starting position after a length of time which depends upon the geographic latitude. At the installation in Paris where Foucault first demonstrated the effect, the pendulum took about 32 hours to return to the starting azimuth, while at either of the poles it would take just 24 hours. Foucault had found a means to demonstrate the rotation of the Earth from a point upon the Earth. It was an astounding demonstration, followed a year later by use of a gyroscope to show the same. However, as Allais lamented, despite the installation of Foucault pendulums at many universities and public buildings around the world, no study of the finer motion of the pendulum had ever been conducted over an extended time period.

Experiments with the glass ball pendulum in magnetic fields of a few hundred gauss did not provide definitive answers to his original hypothesis, and, unable to obtain a device for producing more powerful magnetic fields, Allais turned to a study of the anomalies in the motion of a short pendulum. For this purpose, he constructed a device which he called a paraconical pendulum, suspended such that the full weight of the pendulum rod and bob rested upon a small steel ball. A precision ball bearing resting upon a plane surface provided a very sensitive low-friction apparatus, which allowed the pendulum to swing to and fro in any figure, and to change azimuth in response to whatever forces might drive it. The means of realizing this can be seen in the photographs of the Allais pendulum. Figure 1 shows the detail of the suspension. The weight of the pendulum rests upon a small ball bearing which is held within the removable bearing surface S, made from aluminum. The pendulum weight, rod, and stirrup (E) are made from bronze weighing a total of 12 kg. The horseshoe-shaped cutout in the large aluminum disk S′ (labeled A) allows a rotation of the azimuth of the pendulum of just over two right angles.[2]

1. "My Life Philosophy," *American Economist*, Vol. 333, No. 2 (Fall 1989) as excerpted in *21st Century* (Spring 1998), pp. 32-33, available at http://allais.maurice.free.fr/English/media13-1.htm

2. See Maurice Allais, "Should the Laws of Gravitation Be Reconsidered" (1959) reprinted in *21st Century Science & Technology* (Fall 1998), pp. 21-33. An electronic copy of that reprint is at http://allais.maurice.free.fr/English/media10-1.htm. The paper was originally published in English by the American

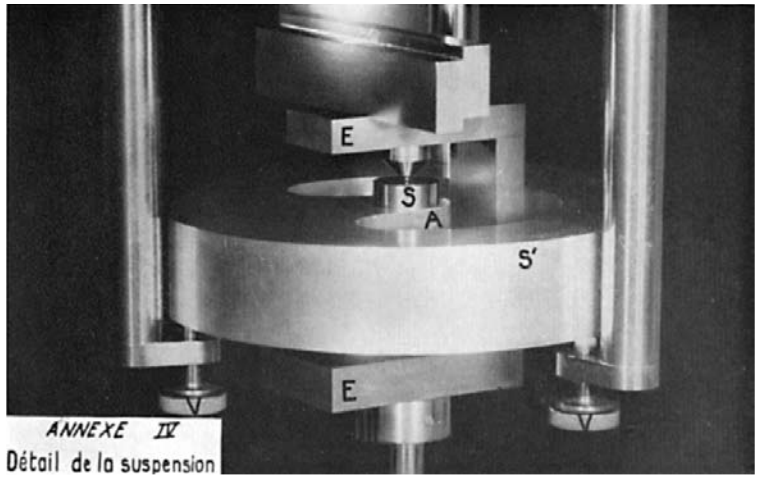


Figure 1
DETAIL OF THE SUSPENSION

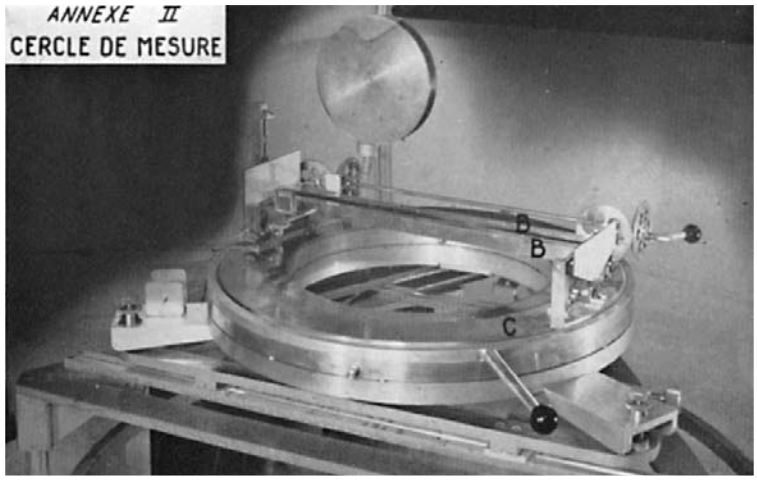


Figure 2
MEASURING CIRCLE

The experiment was conducted by allowing the pendulum to swing freely for a 14-minute period every 20 minutes. The azimuth attained was determined by a graduated measuring circle capable of attaining an accuracy of 0.1 centesimal degrees (Figure 2). (There are 100 centesimal degrees in a right angle and 400 in a circle.) On each re-launching, the ball bearing was replaced with a new one, and the azimuth attained on the previous trial was used as the starting azimuth. The bearing surface was changed at the start of each week. These observations were carried out continuously day and night for periods up to a month during June and July 1955. Three years later, simultaneous experiments at two locations established the same results.

Because of an asymmetry or anisotropy in the modulus of elasticity of the upper support, S", there was a preferred azimuth to which the pendulum might tend to return, barring other effects. (The direction is indicated by the arrow PQ in Figures 3 and 4.) As a result, the pendulum did not rotate through a full 360°, like the Foucault pendulum, but rather varied its azimuth over a range of about 100 centesimal degrees (one-quarter circle). It was the periodicity of the variations in azimuth which proved to be most interesting. After discounting for the Foucault effect and the "return effect" due to the anisotropy of the support, Allais found very strong evidence for a periodic effect, which could not be attributed to any known cause. Harmonic analysis by a mathematical technique known as a Buys-Ballot filter showed that the periodicity manifested itself on a cycle of 24 and 25 hours. Analysis showed that the unknown disturbing influence or influences giving rise to this periodicity was of a strong character, with a strength on average and as a whole about twice that of the Foucault effect.

Luni-Solar Influence?

The rising of the Moon occurs later each day, by an amount varying from about 20 to 80 minutes and averaging about 50 minutes over the course of a month. Thus, the position of the Moon overhead obeys a cycle of about 24 hours 50 minutes. This fact might lead one to suspect that the observed cyclicity in the pendulum data is due to the gravitational effect of the Moon, or the combined effect of Moon and Sun. The behavior of the pendulum during a total eclipse of the Sun on June 30, 1954

Institute of the Aeronautical Sciences at the recommendation of Wernher von Braun. It appeared in *Aero/Space Engineering*, Vol. 18, Nos. 9 and 10 (September and October 1959).

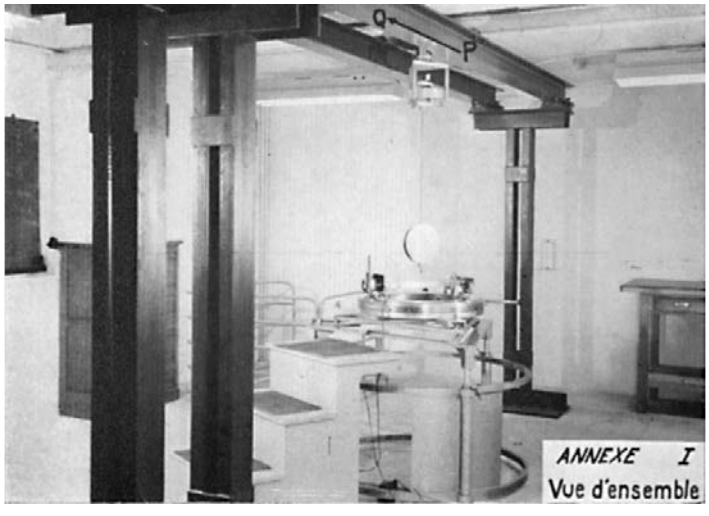


Figure 3
THE ASSEMBLED APPARATUS

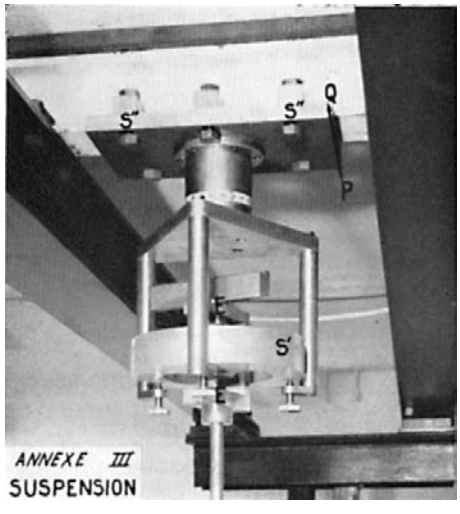
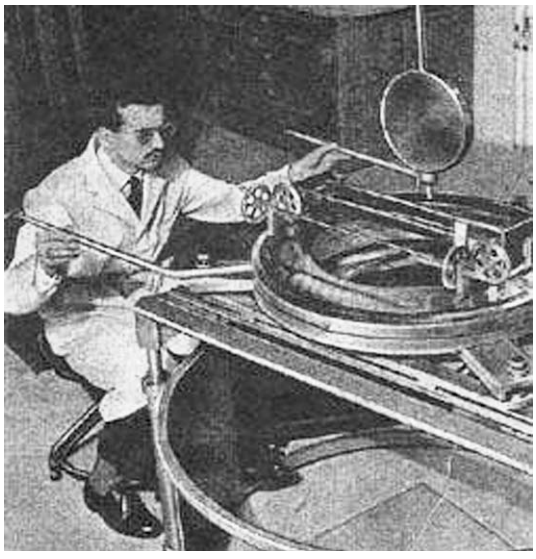


Figure 4
SUSPENSION APPARATUS

gave added reason to suspect a gravitational influence linked to the luni-solar alignment. A sudden variation in the azimuth of the pendulum of a magnitude never observed in any other continuous observation period took place at the start of the eclipse. Similar anomalous behavior of a pendulum during solar eclipses has since been observed by others.

However, an analysis by Allais showed that the difference in gravitational attraction exerted by the luni-solar alignment upon a point on the Earth could not give rise to such variations in the pendulum, for the order of magnitude of such effect is 100 million times smaller than the gravitational field that drives the pendulum's fall. The difference between the attraction of the Sun and Moon upon the center of the Earth, as compared to a point on the Earth's surface, is of the order of 10^{-8}, a value of such insignificance that none of the 19th Century authors who worked on the theory of the pendulum ever took it into consideration. In addition, for the change in luni-solar force to affect the azimuth of the pendulum, one must take into account the difference between the attraction at the mean position of the pendulum and its magnitude at a nearby point, a difference in force of a tiny order of magnitude, equal to 10^{-13} that of the pull of gravity at the Earth's surface.



Jacques Bourgeot, laboratory director, operating the Allais paraconical pendulum, photographed by Maurice Allais. He is operating the measuring circle for the pendulum, which allows measurement of the direction of the swing and the two axes of the flat ellipse which the pendulum bob traces out.

Thus, neither the regular cyclical variation of the pendulum, nor the anomalous behavior at the time of solar eclipse, can be explained by the presently understood theory of gravitation. Something else is at work.

Other Possible Causes

In order to arrive at an explanation, Allais considered a wide range of known periodic phenomena, including the terrestrial tides, variations in the intensity of gravity, thermal or barometric effects, magnetic variations, microseismic effects, cosmic rays, and the periodic character of human activity. Yet, on close examination, the very peculiar nature of the periodicity shown by the change in azimuth of the pendulum forced the elimination of all of these as cause. For the pendulum, the amplitude of the 25-hour wave was of the same order of magnitude as that of the 24-hour wave, and very much greater than the amplitude of the 12 and 12.5-hour wave. Yet for all of the phenomena considered as possible causes, the total of the amplitudes of the waves having periods close to 25 hours is small as compared to the 24-, 12-, or 12.5-hour series.

By the elimination of such causes, Allais was led to his hypothesis of spatial anisotropy which I first learned of on reading a review of his 1997 book, *L'anisotropie de l'espace* (*The Anisotropy of Space*). On closer examination of this work, I discovered the existence of many little-known anomalous phenomena, which he supposed to be evidence of a dissymmetry or anisotropy of space. Among these were the measurements carried out by Ernest Esclangon in the 1920s, when he was the director of the Strasbourg Observatory. These involved certain systematic shifts that occurred in the sighting of a refracting telescope, depending on whether the instrument was aimed toward the northwest or northeast, and showing a periodicity which coincided with the sidereal, but not the mean, solar day. Prior to this, Esclangon had made an analysis of 166,500 hourly observations of the Adriatic tides, which he interpreted as demonstrating a dissymmetry in the sidereal space, not affected by the luni-solar alignment.

Allais believed that the variations noted by Esclangon were closely related both to the results of Dayton Miller's extended observations at Mount Wilson with the upgraded Morley-Miller interferometer,[3] and to his own results from the paraconical pendulum. Indeed, Allais suspected that a wide variety of anomalous periodic behaviors might also be comprehended by this conception of spatial anisotropy. It is instructive to reproduce the list of such effects, which he included in his 1959 paper, "Should the Laws of Gravitation be Reconsidered?":

1. Abnormalities in the tide theory;
2. Motions of the top of the Eiffel Tower;
3. Size of the deviations to the South noted on falling bodies;
4. Variations in the amplitude of the deviations to the east noted on falling bodies;
5. Abnormalities noted in the action of terrestrial rotation on the flow of liquids (Tumlirz's experiments);
6. Abnormalities noted in the motion of the horizontal gyroscope of Föppl;
7. Abnormalities noted in the experiments carried out with the isotomeograph;
8. Abnormalities noted in experiments carried out with a suspended pulley;
9. Various abnormalities noted in geophysical measurements, ascribed until now to experimental errors;
10. The apparently unaccountable results obtained by Louis Pasteur (a general in the French Medical Corps, not the 19th Century scientist) in his experiments on the oscillation of the pendulum (1954);

3. Maurice Allais, "The Experiments of Dayton C. Miller (1925-1926) and the Theory of Relativity," *21st Century* (Spring 1998), pp. 26-34, available at http://allais.maurice.free.fr/English/media12-1.htm, and the accompanying background piece, Laurence Hecht, "Optical Theory in the 19th Century and the Truth about Michelson-Morley-Miller," *21st Century* (Spring 1998), pp. 35-50.

Henry Aujard

Maurice Allais (right) in Paris in 2001, with (left to right) his wife, Jacqueline, Laurence Hecht, Emmanuel Grenier, and Marjorie Mazel Hecht.

11. Remarkable characteristics of the Solar System, for which there has been, until now, no satisfactory explanation.

To these considerations, we would like to add one other case of an unexplained periodicity corresponding to the solar and lunar day, as well as to longer cycles, which came to our attention only recently. The nature of it is such as to lend an added breadth to the considerations raised so far. These are the periodicities in metabolic activity observed in organisms as diverse as crabs, salamanders, potatoes, seaweed, and carrots, as reported some decades ago by Northwestern University biologist Frank A. Brown and colleagues.[4] In one especially provocative series of experiments, Brown and collaborators observed the cycle of shell opening and closing in oysters that had been transported in a photographic dark box from New Haven, Conn. to Evanston, Ill. Maintained under conditions of artificial light, pressure, and temperature, the bivalves nonetheless gradually changed their time of opening to correspond with high tide as it would have occurred in their new, landlocked location.[5] How they received the time signal remains a mystery. Brown later found an inverse correlation of the metabolic activity of these and other organisms to the intensity of cosmic ray flux.

The similarities and differences of these observations of cyclical activity exhibited by living organisms, compared to those of a purely physical nature noted by Allais, are worth closer study. As the experiments of Allais and Brown occurred within the same epoch, some very precise comparison of data may be possible.

I am reminded of a meeting in Paris in the Spring of 2001 at the offices of the political movement associated with Jacques Cheminade. That was one of two occasions on which I had the pleasure to meet Maurice Allais. Also in attendance were the biophysicist Vladimir Voeikov, Allais' associate Henry Aujard, Remi Saumont of the CNRS (National Center for Scientic Research), and others. I recall the enthusiasm with which Allais responded to the suggestion that an international organization be created to carry out investigation along the lines similar to those I have outlined here. That proposal did not take off at the time. Now, however, in a new generation of thinkers associated with Lyndon LaRouche's Basement Project, it has taken shape.

Beyond Sense Certainty

What is most intriguing about the new physical field, of which Allais' experiments give evidence, is the suggestion of an effect not clearly linked to visible objects, nor to any sensible phenomenon of which we are presently aware, even including cosmic rays as presently understood. The introduction of the sort of considerations epitomized in F.A. Brown's works, allows us to more easily view the matter from the standpoint of a universal field not limited to physical effects, in the strict sense, but acting upon the three domains of living, non-living, and cognitive as identified by V.I. Vernadsky.

Here I raise a point of difference with Allais in his formulation of an anisotropy of space, my objection being not so much to the anisotropy, but to the space. There is no empty space; on this point we would not have differed. However, I believe one must go beyond filling the apparent distance between the objects of naive sense certainty with a medium, of whatever composition. Rather than space, time, and matter, we might better say a universal continuum with singularities, borrowing these, actually imprecise, terms from mathematics, for lack of a better image. Thus, the radiation-filled interstellar space is not truly distinct from the objects which appear to fill it, and from this flows the necessity of the next revolution in our scientific understanding, to reconstruct the Periodic Table of Dmitri Mendeleyev from the standpoint, not of particles, but of a universal cosmic radiation or field. I believe that Allais and myself would have found common ground, if not perfect agreement, on this approach, had we had the opportunity for extended discussion of the matter.

Immortality exists as a real and even measurable phenomenon, far more than most today are willing to recognize; the greater the soul, the more manifest. Herein spiritual greatness is distinguished from the common sort of passing fame, which is never won without moral compromise. For such unfortunate cases, in the end, after all the ceremony and intoning of empty words is over, there is little left. It is quite the opposite with great souls, who leave behind a legacy of thought and action from which the living still wish to learn and with which they still desire to consult. In the renewed dialogue I here initiate with my dear friend Maurice Allais, that elementary truth is about to be proven once more.

4. See, for example, Frank A. Brown, Jr., M.F. Bennett, and H.M. Webb, "Monthly Cycles in an Organism in Constant Conditions during 1956 and 1957." *Proceedings of the National Academy of Sciences*, Vol. 44 (1958), pp. 290-296.

5. Frank A. Brown, Jr., M.F. Bennett, H.M. Webb, and C.L. Ralph, "Persistent Daily, Monthly, and 27-Day Cycles of Activity in the Oyster and Quahog," *J. Exp. Zool.*, Vol 131, No. 2 (March 1956), pp. 235-262.

IN MEMORIAM: MAURICE ALLAIS (1911-2010)

A Passion for Truth and the Common Good

by Marjorie Mazel Hecht

Studio Harcourt Paris

French thinker Maurice Allais, who died Oct. 9, 2010, is alone among the Nobel Laureates in economics in making the general welfare, and physical reality, central to his economic theories. For this he deserves our thanks. But Professor Allais was more than just an economist; he wrote many books and papers on history, both ancient and modern, and on various political systems. And in physics, he carried out fundamental studies of the anisotropy of space, and his experiments with a paraconical pendulum found evidence of the existence of a new physical force.

For several decades, Allais pursued the question of causality in both economics and experimental physics, with a passion that is notably lacking in both disciplines today. Nothing deterred his quest, and he continued his research and writing into the last year of his long life. Because his work overturned conventional wisdom in both fields, the awards and honors that he won were not without controversy.

Allais received the Nobel Prize in Economics in 1988, when he was 77 years old, for works that he had written four decades earlier: *Á la Recherche d'une discipline Économique—L'Économie pure* (In Quest of an Économic Discipline—Pure Economics), written between 1941 and 1943, and *Économie et Intérêt* (*Economy and Interest*), published in 1947.

His life-long passion for economics, and for improving the human condition, was sparked by his visit to the United States in 1933, after his graduation and before his military service. It was during the depths of the Great Depression, and he was moved by the terrible social conditions. He wanted to know what caused it, and how to avoid it—how the economy should be organized for the common good.

A Working-Class Background

Maurice Félix Charles Allais was born on May 31, 1911, in Paris, to parents who owned a small cheese shop. His father died in 1915, as a German prisoner of war during World War I, a fact which, Allais said, deeply marked his youth and his entire life.

Allais pursued a higher education, taking top honors in almost all subjects. From college, he entered the École Polytechnique in 1931, graduating first in his class two years later from this elite French science school. From there, Allais entered the National Mining Corps (Corps National des Mines), because it was (and still is) from this Corps that France's industrial leaders were drawn. He then completed a year of military service in the Alpine Army, and two years at the National School of Mines (École Nationale Supérieure des Mines) in Paris, beginning work as an engineer in 1936. A year later, when he was only 26, he was in charge of the mines and quarry service in the Nantes region, and also of the general and local railway systems.

At the outbreak of World War II, Allais served briefly again in the Alpine Army on the Italian Front, returning to his mining duties after the French armistice in 1940, working in Nantes, which was then under German occupation. In 1943, he moved

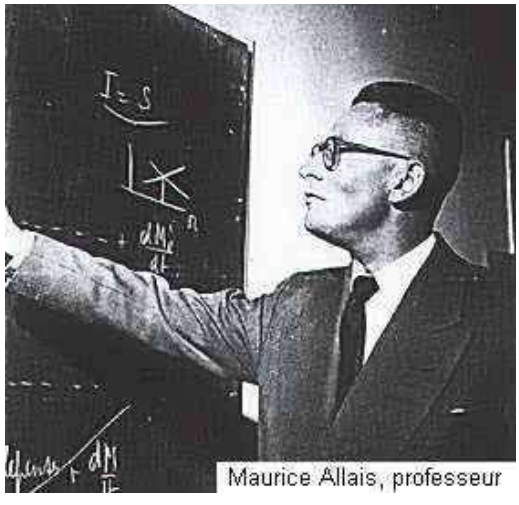
Henry Aujard

Maurice Allais' state funeral Oct. 16, 2010, at the Cathédrale Saint-Louis des Invalides.

Photos courtesy of Michel Gendrot, http://allais.maurice.free.fr/English/

Allais as a child, in front of his family's cheese shop.

Allais as a student at the Ecole Polytechnique, ca. 1932.



Allais as a professor at the Ecole Nationale Supérieure des Mines de Paris.

to the Bureau of Mines Documentation and Statistics Office in Paris, where he remained until 1948. It was here that he began his economic study and writing, working at least 80 hours per week, and writing the works on which the 1988 Nobel Prize was based. He worked intensively for 30 months during what he called "the darkest years of World War II," the German occupation of France, when his work as a mining official was slow.

An engineer by training, Allais taught himself economics, studying all the economics books he could find at the time. Throughout his life, he advised his students to follow the guideline by which he worked: "Read the great thinkers in their original works."

Most impressive, in his own estimation (and that of other French observers), is that Allais managed not only to write a 1,000-page tome (*In Quest of an Economic Discipline*), but also to *publish* it at a time when paper was in extremely short supply. As one of his students put it, that was a real economic miracle!

Allais characterized himself at the time as an "amateur," but, as he stated in his 1988 Nobel lecture, "amateurs possess one very exceptional advantage, that of never having been conditioned by university training and the constant repetition of established truths, and, therefore, of being able to examine every question with a fresh eye, without any preconception and prejudice." Indeed, Allais characterized how he felt about his first economics work, by quoting from a letter by Gottfried Leibniz: "I wished to swim by myself, without any master. . . . Frequently, in the light of a few lines encountered in my reading, I drew the substance of countless meditations."

Allais began his work in economics by looking for a solution to what he called the fundamental problem of any economy, namely how to promote the greatest feasible economic efficiency while ensuring a distribution of income that would be generally acceptable. In the days of wartime occupied France, when he began his economic studies, he considered how best to organize postwar France, developing the foundations on which an economic and social policy could be validly built. Over the years, he continued to elaborate ways in which the economy would run smoothly, without income inequity.

Reality First

After 1948, Allais left administrative work to concentrate on teaching, research, and writing. He was a professor of economic analysis at the École Nationale Supérieure des Mines, a research director at the National Center for Scientific Research (Centre National de la Recherche Scientifique), and he held teaching positions at several other institutions. Although he retired from civil service in 1980, Allais continued his work—teaching, researching, writing, and winning many prestigious awards for both his economic and scientific work.

Throughout his many books and articles, Allais reiterated his philosophy of science and economics, stressing three main points:

1. The elaboration of theories and models in which creative intuition must play the determining role, and which must be in agreement with reality;

2. The use of mathematics as a tool, not as an end in itself. Allais emphasized the abuse of mathematical formalism in economics and elsewhere;

3. The necessity for constant questioning of established truths, which, he said, often tyrannically outlaw new ideas, even when these are more in agreement with reality than the established view. "Science is perpetually growing, always sweeping out established truths," he wrote. "It is the future which is the final judge of the works of man."

Attacking the 'Casino Mondiale'

Although Allais wrote in 1989 that he was more concerned with understanding what men do, than with convincing them, nevertheless, he campaigned in the news media to influence public policy. In the late 1980s, as the world economy disintegrated, Allais took his views to the French public with a series of commentaries in the leading newspapers condemning the *casino mondiale* (world casino), the shift in the world economy

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Maurice Allais and his wife, Jacqueline, at a 2001 seminar in the Paris office of Solidarité et Progrès. Mrs. Allais died in 2003.

away from production of real goods and into pure financial speculation, and warning of a crash to come, unless changes were made. In the early 1990s, Allais added a detailed attack on globalization to his critique of the existing national and world monetary systems.

In this effort, he joined economist Lyndon LaRouche on more than one occasion in calling for fundamental reform of the international monetary system. In a 2008 public statement, he wrote: "Mr. Lyndon LaRouche and his organizations have frequently supported ideas near to my own proposals for fundamental reforms of the international financial and monetary systems, which I have publicly backed for many decades."

Speculation vs. Physical Economy

The clearest way to understand Allais' economic concepts is to see how he applied them to the financial crisis that erupted in October 1987. In a series of polemical articles in the popular press, Allais argued against financial speculation, for tighter government regulation, and for investment in the national physical economy to spur growth. In a front-page article in the national daily *Le Monde,* on June 27, 1989, titled "From Crash to Euphoria: The Plague of Credit," Allais wrote:

> My key conclusions are that, just as in 1987, in fundamental terms, the world economy is potentially unstable; that its short-term evolution is essentially unpredictable; and that in order to do away with that potential instability, the international financial and monetary institutions ought to be thoroughly reformed.
>
> The whole world economy rests upon gigantic debt pyramids that mutually sustain one another in a precarious balance. Never in past history had there been such an accumulation of promissory notes. Never had it been so difficult to honor such promises.
>
> Whether it is currency or stock speculation, the world has become one vast casino where gambling tables are spread over all meridians and latitudes.... Speculation everywhere is boosted by credit-issuance, since one can buy without paying and sell without owning.... All our difficulties stem from ignoring the fundamental reality, that no [market system] may properly operate if uncontrolled credit creation of means of payment *ex nihilo* allows (at least temporarily) an escape from necessary adjustments.

In an Aug. 27, 1992 interview with the Spanish newspaper *El País,* Allais stated:

> The Western stock exchanges are nothing but complete manipulation. It's a game, taking positions, and then playing not at forecasting events, but playing at divination, what others may think of those events. There is one image which illustrates the problem: people living and working beside Mount Aetna. No one knows when the next eruption will occur. We are in the same situation today.

Allais continued to polemicize against the major trends in the world economy in the 1990s: globalization and free trade. Writing in the daily *Le Figaro* on Nov. 15-16, 1993, Allais roundly criticized the study by the World Bank and the Organization for Economic Cooperation and Development (OECD), "Trade Liberalization: Global Economic Implications." He specifically defended agricultural subsidies against attack, again stressing the reality of the physical economy as opposed to monetary speculation based on credit *ex nihilo.* He showed that French agricultural subsidies, in real terms, represented only three one-thousandths of a percent (.003%) of the GDP of France. He concluded that the World Bank/OECD conclusions were exaggerated by a factor of between 100% and 1,000%! Allais wrote:

> I want to warn against the conclusions of this study, which are based on a highly controversial model of world trade, above all on an incorrect estimation of the gains possible from global free trade....
>
> How do we correctly evaluate the order of magnitude of real costs of agricultural subsidies? We must distinguish between the volume of subsidies and the real cost to the economy, because the subsidies go to create real physical income to the economy. The proper evaluation of this real cost of subsidies is one of the most difficult questions of economic analysis....
>
> The World Bank and OECD bear much of the responsibility for the drive for trade liberalization. The World Bank prediction of enormous "gains" to the world

economy is intended to influence political policy, using the mask of pseudo-science, which can only fool the naive. To make decisions which have great consequences for many tens of millions of people in the world based on such conclusions, would be ludicrous. The World Bank report is a gigantic mystification on behalf of a simplistic ideology, the ideology of dogmatic and uncontrolled free trade.

Through the 1990s, Allais continued to criticize the dogma of free trade, globalization, floating exchange rates, and the deregulation of the financial markets. He warned that these policies were destroying national economies, engendering unemployment and instability, de-industrializing, and reducing the rate of growth of living standards. He was especially critical of the European Union's policy toward China, forcing it into low-value-added activities. Similarly, he criticized EU policies toward the former Soviet states.

Allais wrote a paper in 1991 (revised in 1992), putting forward a solution to the devolution of the world economy, titled "The Monetary Conditions of an Economy of Markets: From the Teachings of the Past to the Reforms of Tomorrow." In the face of the unstable situation, Allais concluded that "the basic principles upon which the present monetary and financial system rests, on the national and the international level, have to be entirely thought out anew."

Allais laid out two basic principles for the necessary reform, which would prevent the creation of money from nothing:

> The realm of monetary creation must pertain to the State, and the State only. The Central Bank must therefore be given the total mastery of the money supply.
>
> Monetary creation other than that of the monetary base by the Central Bank must be made impossible, so as to prevent any one other than the State from enjoying the fictitious claims that currently stem from the creation of bank money.

Allais described the *ex nihilo* creation of money by the banking system as identical to the creation of money by "counterfeiters," the only difference being that those who profit are different. He proposed, therefore, that although all banks would be private, except for the Central Bank, all income derived by the Central Bank's creation of money should be returned to the State, enabling the latter, under present circumstances, to do away with practically the whole of the progressive tax on income.

This would eliminate the present circumstance where profits and their beneficiaries are not transparent. Such revenues, he wrote, "merely generate inflation, and by encouraging investments that are not really profitable for the community, they only generate a wastage of capital."

In Memoriam: Maurice Allais

by Jacques Cheminade

PARIS, October 11, 2010—I just learned last night of the passing away of Maurice Allais. The only French Nobel Prize laureate in Economic Sciences has left us, without the written press of this morning paying him due homage.

Indeed, for a certain time, *Le Figaro* refused to publish his articles, and only *l'Humanité* (the French Communist Party daily) and, last year, the weekly *Marianne*, had opened their pages to him.

Today, *Le Figaro* is more prolix, but no media mention that Maurice Allais was always a defender of the separation of the activities of investment banks, deposit banks, and investment banks (his vision of the Glass-Steagall), and that he had explained, demonstrated, and announced for more than a decade, in numerous books and articles, the world financial catastrophe which occurred during the Summer of 2008.

Logically, Maurice Allais became associated with the wide public debate begun by Lyndon LaRouche, in favor of radically refounding the credit system and the international monetary system, underlining that on essential points, Mr. LaRouche and his organizations had "often supported ideas close to my own proposals for fundamental reform of the international monetary and financial system." In his letter of Nov. 27, 2009, he had authorized us to make this statement public. [http://www.solidariteetprogres.org/article6075.html]

This "liberal socialist," who, to me, was neither one nor the other, but rather an expert of fundamental physics who looked at the economy from the standpoint of equipment and production, and not simply from a monetarist vision, liked to state that only one of his students lived up to that name, Gérard Debreu. Many other leaders and French officials, however, such as Dominique Strauss-Kahn, Marcel Boiteux, Thierry de Montbrial or Jean-Louis Bianco, had also followed his classes.

Personally, along with Louis Armand, Pierre Massé, Philippe Lamour, and the teams of the Planning Commission, during my early years of study, I was immersed in the spirit which the works of Maurice Allais had inspired in our country.

Let this spirit be reborn, beyond the present disarray and incompetence, and inspire those who are aghast by the dominant financial system, that they find a means to come out of it from the top down, not in seeking the issues of a regressive past, but in a future of science and innovation, at the heart of what Maurice Allais always defended, an economy in which man is responsible for his species and for nature, discovering, applying, equipping, and producing.

There is urgency, an extreme urgency, for a world whose financial system is disintegrating and becoming decomposed, needs a new generation of leaders, in the image of a man of character as was Maurice Allais.

Jacques Cheminade is the Presidential candidate of Solidarité et Progrès in France, and a cothinker of Lyndon LaRouche.

Allais also proposed measures to fundamentally reduce uncertainty concerning the future, by indexation—for example, linking of wages to prices—that would maintain efficiency in the economy and equity in the distribution of income.

Thatcher's New Versailles

In the 1980s and 1990s, Allais penned several articles on contemporary political issues. He defended German Chancellor Helmut Kohl's decision to unify Germany in 1989, and sharply criticized British Prime Minister Margaret Thatcher's opposition to this unification as being in the 19th Century tradition of Britain's "divide and conquer" strategy. In the March 12, 1990, *Le Figaro,* Allais wrote:

> The efforts of all those now who, directly or indirectly, stand in opposition to the reunification of Germany and its implications, are fundamentally identical to the efforts deployed after the First World War to reach the Treaty of Versailles, efforts which led in the end to the Second World War. We must choose: Either we create a situation which risks leading us, sooner or later, to a third world war, or we participate, loyally and without second thoughts, in the integration of a reunified Germany in a united Europe.

Allais opposed the war in Iraq launched by U.S. President George H.W. Bush, as well as the role of U.S. "coalition" partners in the Mideast. Writing in *Le Figaro Magazine,* on July 23, 1991, Allais said in respect to the Gulf War:

Without question, since the collapse of the Berlin Wall, on November 9, 1989, a new era of the history of the world had begun. The world today must be reformed and a new international order is necessary. However, this international order should not be based on the oppression and humiliation of some and the insolent domination of others. The new international order that we strongly feel we need, must be based on equity and on justice, on an equal respect for all peoples, not proclaimed on by-ways in solemn declarations, but practiced in concrete realities each day. It must be founded on ethical principles that are at the basis of our humanist civilization.

Worldwide recognition of Allais' pioneering work in economic theory came late in his career, partly because his works were not translated from French, and, more so because he trampled on accepted academic economic dogma. Allais' promotion of State intervention in many areas, and his idea that economics should further the general welfare, especially offended economists of the Austrian School. But popular acclaim was not his goal. As he commented in the conclusion to his 1988 Nobel lecture:

> *Whatever the price he might pay for it in his career,* the scientist should never steer his course according to the fashions of the day, or the approval or disapproval of his contemporaries. His sole concern must be with the quest for truth. This is a principle from which I have never departed" (emphasis in original).

Study Suggests Low-dose Radiation May Reduce Lung Cancer Deaths

Dec. 8, 2010—The benefits of low-level radiation were hinted at in a recently completed National Cancer Institute (NCI) study of 53,000 heavy smokers with a high risk for lung cancer.

The NCI study, carried out at 33 major medical centers across the country, examined volunteers, aged 55 to 74, who had smoked the equivalent of at least a pack a day for 30 years. Starting in 2002, participants were randomly assigned to one of the two screening groups, CT or X-ray. Members of each group received three annual screenings and were then followed for at least five years. A CT scan (low-dose helical computer tomography) of the type employed in the study, provides 1.5 mSv (millisievert) of low-dose X-ray radiation, about double the radiation of a chest X-ray (0.8 mSv).

National Cancer Institute

Videograb of a patient undergoing a CT scan. The video can be watched in full at http://www.youtube.com/watch?v= azUn05s1dC4&feature=player_embedded#!

The study, intended to compare the screening capability of the two methods, now also suggests that mere exposure to the higher radiation dose of the CT scan may have contributed to a reduction in the numbers of deaths from lung cancer. Participants receiving the CT scan experienced 20 percent fewer deaths from lung cancer, after five years, as compared to those who received a conventional X-ray.

The group receiving the CT scans also experienced a 7-percent reduction in deaths from all causes, including lung cancer. It remains to be determined what portion of the health benefit may derive from the improved screening effect of the CT scan devices, and what from the known benefits of low-dose radiation.

Lifesaving Results

There is no ambiguity about the lifesaving results, and for that reason, the NCI stopped the study early to announce the findings. There were 442 deaths from lung cancer among the trial group receiving the X-ray, compared to only 354 from the CT scan group.

Harold Varmus, director of the NCI, said: "Lung cancer is the leading cause of cancer mortality in the U.S. and throughout the world, so a validated approach that can reduce lung cancer mortality by even 20 percent has the potential to spare very significant numbers of people from the ravages of this disease."

Denise Aberle, M.D., national principal study investigator, stated: "The results of this trial provide objective evidence of the benefits of low-dose helical CT screening in an older, high-risk population and suggest that if low-dose helical CT screening is implemented responsibly, and individuals with abnormalities are judiciously followed, we have the potential to save thousands of lives."

Benefits of Low-Dose Radiation

The health benefits of low-level radiation have been known for more than 50 years, but specialists who have advocated its use have been stopped by the prevailing belief known as the Linear No-Threshold (LNT) theory. According to this theory, because high doses of radiation are harmful, lower doses are proportionally harmful. The unscientific argument is equivalent to saying that because you can drown in water, any amount of water is bad for you.

But thousands of scientific studies on human beings and animals have demonstrated that below a certain threshold, radiation is beneficial. Trials in Japan and in the United States, showed that exposure to full-body low-dose radiation before targetted radiotherapy treatment for non-Hodgkin's lymphoma, can reduce the required amount of radiation and dramatically improve survival rates. Low-dose radiation therapy also prevented amputation and saved the lives of patients suffering from gas gangrene infections.

According to Dr. Myron Pollycove, Professor Emeritus of Laboratory Medicine and Radiology at the University of California at San Francisco, low-dose radiation helps to fight cancer and other disease by strengthening the immune system and by other means. The radiation stimulates cellular antioxidant prevention of DNA damage by free radicals, enzymatic repair of DNA damage, immunologic destruction of DNA damaged cells by killer T lymphocytes, and self-destruction (apoptosis) of DNA damaged cells.

The just-released study, suggesting that a reduction in lung cancer and overall death rates may be partially due to the exposure to low-dose radiation, opens the door to a serious revisiting of the proven benefits of low-level radiation. It is time to bury the unscientific Linear No-Threshold theory, and carry out both theoretical studies and medical testing to refine our knowledge of the lifesaving benefits of low-dose radiation.

The short-term benefits will include the saving of many millions of lives. In the longer term, an improved understanding of the interaction of life with radiation of all types will open the door to a deeper understanding of many still unsolved problems of fundamental science, and prove of practical importance in mankind's next great step forward, into the Solar System.

—The Editors, 21st Century Science & Technology

For Further Reading

Jim Muckerheide, "The Health Benefits of Low-Dose Irradiation" www.21stcenturysciencetech.com/articles/ nuclear.html

Jerry Cuttler, "Low-dose Irradiation Therapy Cures Gas Gangrene Infections" www.21stcenturysciencetech.com/Articles 2007/20_1-2_Gangrene.pdf

WORLD ENERGY CONGRESS 2010

Lofty Goals Bogged Down in Green Idiocy

by Robert Hux

The 21st World Energy Congress brought together 2,100 delegates from 137 countries, in Montreal, Sept. 12-16, to discuss how the nations of the world can collaborate to meet the urgent energy requirements of the 3.5 billion people who have little, or no access to electricity. Yet, many of the political, government, and industry leaders who addressed the conference seemed to be on an opposing or, at best, contradictory track, supporting policies that can only keep people in the dark.

Many speakers, for example, acknowledged the dominant role that fossil fuels play in meeting the world's energy requirements, now and probably for more than a few decades to come, at the same time that they promoted onerous economic policies based on the fantasy that the carbon dioxide (CO_2) resulting from burning these fuels must be prevented from entering the Earth's atmosphere, lest it cause a runaway global warming, melt the ice caps, and destroy human life on the planet.

Ilko Dimov

A panel discussion chaired by Christian Paradis, Canada's Minister of Natural Resources. Paradis advocates privatizing Atomic Energy of Canada and its CANDU reactors.

Another common refrain was that we must use "all available energy sources." Thus, many speakers described the efforts of their nations to generate significant amounts of electricity from very low energy flux density sources, such as solar radiation or wind. Excluded from these unrealistic presentations, however, was any mention of the energy and labor investment to manufacture and maintain solar and wind installations, to build the back-up power plants needed to compensate for the intermittent performance of solar and wind, to increase the capacity of the transmission grid to accommodate intermittent sources, to acquire the necessary large land areas—the total of which vastly exceeds the amount of electricity that solar and wind might generate. In other words, the net energy generation from solar and wind is *negative*.

These contradictions did not go unchallenged. A small group of organizers associated with the Lyndon LaRouche political movement and *21st Century Science & Technology* were on hand to shake up the otherwise green-business-as-usual conference.

The Green Dead End

The green agenda skewed the discussions away from the aim of bringing electricity to the entire world, starting at the beginning of the week-long conference. At the Sunday evening opening ceremonies, Quebec Premier Jean Charest welcomed the delegates, noting that Quebec is an appropriate place to hold such a conference because not only is 95 percent of all the electric power here generated from a renewable source [hydro power], but Quebec is also second in installed windmill power in North America!

Then, the head of the European Parliament, Jerzy Buzek, spoke about the Lisbon Treaty's requirement for "solidarity in energy supply," "the need to adapt public thinking," and "the benefit of building huge 10,000-megawatt wind farms to take advantage of economies of scale."

Buzek even expressed concern that some countries seem to be distancing themselves from the Copenhagen meeting on climate change. "If you want to keep temperature low, you must reduce carbon emissions.... There are two linked problems: fighting climate change, and growing energy demands."

Ban Ki-Moon, Secretary General of the United Nations, then informed us that the energy required for everyday life has yet to reach the undeveloped countries, and called for a 40 percent increase in energy efficiency by 2040. In other

IISD

Quebec Premier Jean Charest is proud of Quebec's wind power.

European Parliament

European Parliament head Jerzy Buzek advocates more wind farms.

Pierre Gadonniex, chairman of the World Energy Congress, stressed the need for climate protection.

words, no increase in energy production, just more efficient use of the already inadequate supply.

Finally, Pierre Gadonniex, chairman of the World Energy Congress, and honorary chairman of Électricité de France, laid out for the conference delegates what he considered the agenda: "economic growth," "climate protection," and "social issues."

Concern for "global warming" shaped even the better presentations: Although the chairman of the Canadian Space Agency, Steve MacLean, had some fascinating observations on human activities in space, his concluding remarks focussed on the application of satellite technologies to accurately monitor changes on the Earth, including their application to monitoring carbon dioxide emissions.

Economic Reality

Our interventions as the Congress progressed were directed at bringing economic reality into the vacuous agenda elaborated by the Congress chairman.

In a session on African development, for example, *21st Century* correspondent Ilko Dimov told the World Bank Africa representative, "I am surprised at the pessimistic tone of the conference, and that there is no clear objective of fighting poverty."

Dimov gave two examples of how things could be changed positively. When the United States was collapsed in the Great Depression in 1929, he said, Franklin Roosevelt, as soon as he was elected to the Presidency, took swift action, by introducing the Glass-Steagall Act, to reorganize the banking sector and make credit available for the Tennessee Valley Authority and other projects that created employment and gave hope to the country.

"Within three weeks, Franklin Roosevelt reorganized the entire global system," Dimov said, cancelling the debts from the Versailles Treaty, creating a new currency. The second example, Dimov posed was the economic miracle in Europe, in Japan, South Korea, and Germany. "I want to hear your opinion," he asked the World Bank representative. "Today we have $1.4 quadrillion in financial derivatives. The biggest elephant in the room is the economic crisis. It will not end without swift reform. We have a fight in the U.S. Senate. I would like to see the representative of the World Bank address this. I would like to see what he thinks about these two examples."

But the World Bank representative ignored Dimov's question.

The Sept. 12 press conference of African Development Bank President Donald Kaberuka, was to define the focus of the conference about to begin, by looking at the case of the continent where a "child can go from birth to death without ever seeing [electric] light." He described

Africa Development Bank President Donald Kaberuka: Africa is a continent where a child can go from birth to death without ever seeing electric light, as the night map of the continent shows.

royaldutchshellplc.com

Peter Voser, chief executive officer of Royal Dutch Shell plc, promoted natural gas from shale.

the largely untapped potential of the Congo River which could generate 40,000 megawatts with the construction of Grand Inga Dam, which is projected to cost $40 billion.

In response to a question from a journalist on the role of nuclear energy in the development of Africa, Kaberuka asked why Africa should be an exception.

This author then pointed to the fight in the United States to re-enact Franklin Roosevelt's Glass-Steagall banking act, which would make possible large amounts of government-generated credit to finance great infrastructure projects, such as the North American Water and Power Alliance (NAWAPA). "What are the great projects in Africa that would become possible, if it did not have to depend upon private financing and the markets? What about, for example, the project to divert the Congo River to replenish Lake Chad?"

Mr. Kaberuka replied: "if such legislation exists [Glass-Steagall], I would be very interested in seeing it. Lake Chad is a small proportion of what it used to be, but we have to be careful, we don't want to make a mistake."

Energy Flux Density

The keynote speakers on the first day, continued the green agenda of the conference, avoiding mention of advanced energy flux dense sources of power. Khalid Al-Falih, president and chief executive officer of the Saudi Arabian Oil Company, noted that for the foreseeable future the world will continue to rely upon traditional fossil fuels, and while the share of fossil fuels may decline over the longer term, the absolute quantities of energy from these sources will continue to rise because total energy demand will expand significantly.

Over the next five years, he said, Saudi Aramco will concentrate capital investment in the gas and downstream oil sectors with the objective of developing cleaner fuels from refineries, and a CO_2-enhanced oil recovery demonstration project, that boosts oil production by injecting CO_2 that otherwise would have been emitted into the atmosphere back into the reservoir.

Peter Voser, chief executive officer, Royal Dutch Shell, plc (the Netherlands), pointed to the increasing role natural gas will play, in part because it produces less carbon dioxide when burned, but also, he claimed, because of improvements in the production of natural gas from shale.

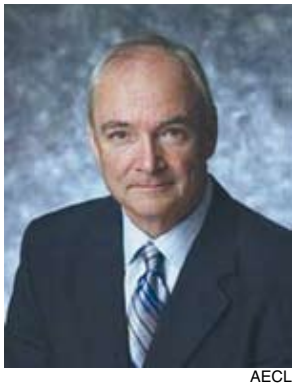
Voser noted that natural gas reserves in North America, which a few years ago were thought to be declining, are now known to be sufficient to last more than a century. There also has been a diversification of natural gas involving liquefied natural gas (LNG) and gas-to-liquid (GTL) technologies. Voser talked of the need for commitment to develop demonstration plants, especially those involving carbon capture.

We intervened here by noting the foolishness of the "19th Century dependence on chemical combustion," which the British empire, as indicated by these two keynote presentations, had stressed, instead of giving nations the power to develop with nuclear fission and fusion. In fact, we discovered that fission and fusion were what people attending the conference were interested in hearing, as indicated by the standing-room-only crowds at the presentations on nuclear energy.

Nuclear Highlights

Some highlights of the nuclear presentations:

- Hugh MacDiarmid, president of Atomic Energy of Canada Ltd., reported that "We are in the middle of a resurgence of nuclear technology, with nearly 60 reactors currently under construction."
- The former Energy Minister of Korea, Ssang-Su Kim, proudly described how Korea had transformed itself from a third world nation, to a modern industrial power by mastering the principles of nuclear energy (see box, p. 43).
- A representative from China proudly stated that his nation intends to build 28 nuclear plants.
- The Deputy Director General of Russia's State Atomic Energy Corporation (ROSATOM), Peter Shchedrovitskiy, reported that Russia currently has 27 nuclear reactors which produce 163 terawatt/hours per year of electricity, and they plan to double this in the next 5 years. He said Russia is developing a new fast nuclear reactor which has a closed fuel cycle reprocessing the spent fuel. In addition, a new small transportable nuclear reactor of 1 megawatt capacity is being developed (see interview).
- P. Uma Shankar, the Power Secretary for India, reported that 20 percent of the regions of India do not have access to electricity, as of 2005. "If you look at energy consumption," he said, "India has



AECL

Hugh MacDiarmid: president and CEO of Atomic Energy of Canada: We are in the middle of a resurgence of nuclear technology.

Ilko Dimov

Sushilkumar Shinde, Union Minister of Power: India must use the clean power of nuclear.

17 percent of the world's population, but consumes only 4 percent of the world's energy. India must increase its energy use, he said, and plans to increase its energy consumption by a factor of six by the year 2035."

Shankar noted that, with "clean coal" technologies, the increase in carbon dioxide emissions would not exceed a factor of three.

• India's Union Minister of Power, Sushilkumer Shinde, referred to nuclear energy as a source of "clean power" which India must use.

Develop the Biosphere!

We found tremendous interest in LaRouche's development policies among the people with scientific and engineering backgrounds, as some of the interviews indicate.

A few delegates to the conference stopped to talk to our organizers outside the conference, to protest the reliance on fossil fuels and support of fission. They were acting upon their recognition of a fundamental principle of economics, whereby the power to accomplish work increases with the increase of energy flux density. As our organizers reminded them, the weight of the fuel required to produce a given quantity of energy, dramatically decreases as you progress from coal, to oil, to natural gas, to uranium (nuclear fission) to deuterium (for nuclear fusion). We stressed that by going to higher energy flux densities, we can accomplish something which would otherwise be impossible.

One organizer posed the following question to people he met: "What do you think about the plan to starve out the green plants, by taking away their carbon dioxide?" This allowed people to begin to consider that there is something going on inside green plants, a process called photosynthesis, which reflects this principle. As a result of a complex process centered around the chlorophyll molecule, visible light is able to split water into its components, hydrogen and oxygen, something that does not happen outside of living photosynthetic organisms.

In addition, carbon dioxide is combined with the hydrogen released from water to build sugars, and more complex carbohydrates. "You don't have to pay $100/ton to get rid of carbon dioxide! The plants will do it for free!"

Telling people, that "we are not interested in simply bringing electricity to people who don't have it, we have to develop the biosphere!", we introduced people to LaRouche's revival of the North American Water and Power Alliance (NAWAPA). We described how NAWAPA, by diverting about 20 percent of the freshwater runoff of the Yukon and Mackenzie river systems of Alaska and the Yukon, into a system of reservoirs, canals, tunnels, and pumping stations makes available 160 million acre feet of fresh water for distribution across Canada, the western United States, and northern Mexico.

Many of the conference delegates and others, including the directors of energy and engineering companies, were struck by the idea that covering large parts of the desert or arid regions of North America with trees or other green plants, would not only require large amounts of carbon dioxide, but that this would give man the power to deliberately change the climate by significantly increasing rainfall.

Over the week-long conference, it was clear that there was a great divide between the nations going with solar and wind, premised on global warming, vs. those nations going with nuclear fission, breeder reactors, and research on thermonuclear fusion. And in between are the many less-developed nations which want to develop more advanced technologies but are pressured to waste resources going with the so-called green alternatives.

Videograb from physicsworld1

Fusion was on the agenda for the WEC. Sir Chris Llewellyn Smith, former chairman of the ITER Council, called for an "Apollo-style" approach to fusion, in his talk, "Fusion—Will It Ever Be a Reliable and Competitive Source of Energy?" "We must pursue this option as soon as possible," he said. "We should start building the demonstration reactor in parallel with ITER. There is nothing like learning by building. Get on with it and show the world that we can produce energy." For a short video from the conference, see http://www.iter.org/newsline/148/438.

Ilko Dimov

Fatih Birol (left), Chief Economist of the International Energy Agency, told the conference that "whatever energy policy China, with its 1.3 billion people, follows will have a crucial impact on the global development." With Birol on the podium are Vinay Kumar Singh (center) and Thierry Vandal.

INTERVIEW: DR. KUNMO CHUNG

Korea's Bold Plans for Nuclear Power and Space

IEC

Dr. KunMo Chung: Koreans are optimistic!

Dr. KunMo Chung, former South Korean Minister of Science and Technology, was interviewed by 21st Century *correspondent Ilko Dimov, on Sept. 15, 2010.*

Dr. Chung is an internationally known energy engineer and science and technology educator. In addition to serving as Minister twice, he is former chairman and CEO of the Korea Science and Engineering Foundation, and former President of the Korean Academy of Science and Technology. Internationally, Dr. Chung held posts as President of the General Conference of International Atomic Energy Agency of the United Nations, Vice Chairman of the World Energy Council, and Chairman of the International Nuclear Energy Academy.

Dr. Chung is internationally known for his innovations in the design of electric power plants and science policy studies. The Korea Power Engineering Company, which he headed in the 1980s, has become one of the leading engineering companies in the world. The Korea Standardized Nuclear Power Plant Design was initiated, developed, and implemented under his leadership.

Question: One of the interesting things you mentioned in your presentation is team work. You're building teams and doing large-scale training for nuclear power plants of young people in Korea, and also foreigners.

We welcome qualified young engineers to come to our school, because, as in the United States, the average age of professionals working in our nuclear power plants is 59 years old. They are looking for retirement, and you actually have a manpower crisis.

We invite promising young engineers to come to our school to become leadership professionals. And I am making this very clear: Our school is really an international school, taught jointly by Koreans and overseas people.

We have a bilateral agreement with Mid-Atlantic Nuclear Power Educational Consortium. Those mid-Atlantic states are, as you know, Virginia, Maryland, and North Carolina. Duke Power has seven pressurized water reactors, Virginia Dominion Energy has four pressurized water reactors, and Maryland's Constellation Energy has two plants and is building more.

This is the center for U.S. PWRs, and so we are going to have exchanges with this new mid-Atlantic group and our Korean school.

Question: I would like to know more about your frontiers of science. What are the biggest challenges right now for the Korean nuclear industry?

Right now, the most important human resources in nuclear power plants are systems engineers. In my view, the current nuclear reactors, although they are called "generation 1, 2, or 3," have much ground still unexplored for optimizing the design. We need to really optimize it, so that we can save construction time and money.

So far, we have steadily shortened the construction time. Now it takes 48 months for standardized nuclear power plants, but in the future, we think we can cut this to below 36 months. In planning the time for any plant, you cannot take 10 years. Nobody wants to deal with that. So I believe there will be a revolution coming in the design of nuclear power plants. There will be no more custom designed and custom constructed nuclear power plants. They will be very much standardized and built in a factory-like environment.

Korea Nuclear Energy Foundation

Korea's Uljin Nuclear Power Plant has six units, two reactors of 950 megawatts and four at 1,000 megawatts. Reactors 3 and 4 at the site set up Korea's standard light water reactor model.

Then we can have, as I mentioned yesterday, modularization in design and manufacturing construction. This is on the way.

Question: Great! One of the things you mentioned in your presentation was the specialization in modular construction.

Yes, that is what we are pushing for now. Because, emerging nations don't have enough people. What they need is electricity—they don't want to become nuclear exporters.

Question: Many countries from the developing world—Africa, Asia, the

Ilko Dimov

Dr. Chung has patented a design for barge-mounted nuclear plants that can be constructed in 30 months.

Middle East—recently announced plans to construct nuclear power plants.

That is correct: 70 nations in all.

Question: Your country achieved excellence in a very short period of time. What advice do you have for these countries? What do they have to do? What is the model for the Korean miracle you achieved? As a Third World nation coming out of a terrible experience after World War II, how were you able to achieve this excellence?

Well, in our time, we followed the traditional approach. We set up nuclear energy research institutes, and we went through our first nuclear power plant on a turn-key basis, with the entire plant supplied. Then we switched to a component basis with just the components supplied, and from there we went on to have our own standardized design, and so on.

It took a long time for technological self-reliance and this kind of optimization process—it took 50 years. Some people say 30 years from the first commercial operation, but from the start of our first experimental reactor it took 50 years.

I don't think many nations are that patient anymore. They need electricity for their people. So this requires a new approach: in my view, a kind of alliance with a country like Korea, which would be a compassionate partner for these countries. For example: I am an advisor to Kenya, a national advisor on the Social and Economic Council, and I have given talks on nuclear energy—How Kenya can do it.

For that I suggest initially, let's put the emphasis on how to get nuclear electricity in the shortest time, safely, and with security. And for that we need a global cooperation alliance.

I suggested a transportable barge-mounted nuclear power plant, constructed at a shipyard and moved over to the site, and then connected with the grid. I have a basic patent for this. For its transportation, we don't need any nuclear fuel, just the barge. And once you prepare the site, we can cut down the construction time easily to 30 months.

Question: Thirty months, that's wonderful!

I also wanted to ask you about fusion. Under your ministry, you said that you initiated the fusion program. And right now, you have a great achievement in the KSTAR tokamak reactor, which is a smaller version of the ITER tokamak they are constructing in Europe right now. And many of the scientists who will be working in Europe were trained in Korea. Dr. Gyung-Su Lee, the head of the Korean fusion program, has a very optimistic view about achieving controlled fusion.

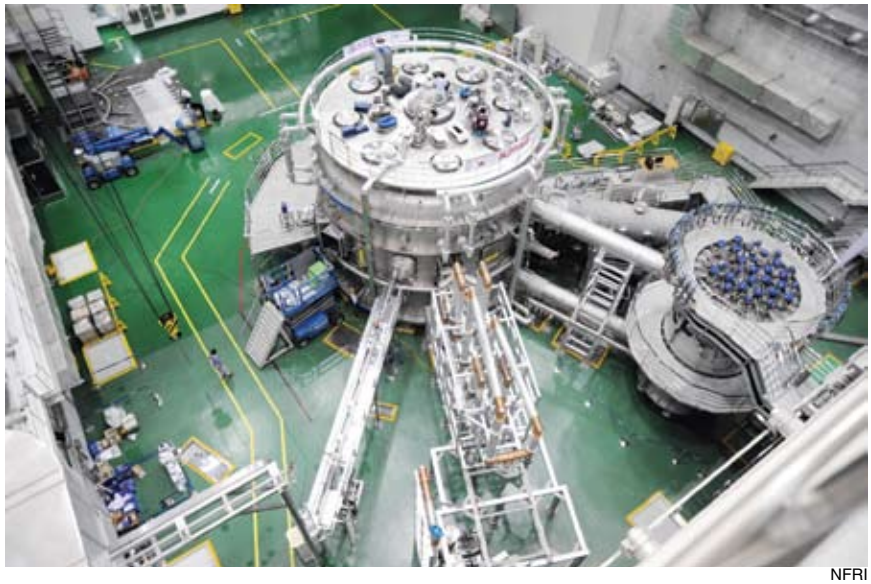
Yes. I read the article you gave me [Interview with Dr. Gyung-Su Lee, "Fusion in Korea: Energy for the Next Generation," Winter 2009/2010]. Among Koreans, I am the first fusion scientist! I did my experimental work at the Princeton Plasma Physics Laboratory in 1963. At that time, the leading machine was a stellarator. I devised an ion heating device on that machine, which was very successful.

Now, of course, Dr. Lee is in charge of the program. Back then, fusion research was carried out with a university-based experiment, a very small tokamak, employed by Seoul National University. Then we discussed how to make a real tokamak, and so on. When I became Science Minister—I served twice in the government, the first time in 1990 and the second time in 1994—during my first ministry, I provided funding for plasma scientists to bring in a tandem mirror reactor.

Then, in 1995, I thought there should be a basic research device. The best basic research device was a plasma machine, because it requires a high vacuum and also a super high magnetic tube and a microwave heating system—a combination of high technologies. So I began the construction of the fusion device. At that time we had good people like Dr. Gyung-Su Lee, and other associates available. During my time, earlier, I was the only one.

Question: During our interview with Dr. Lee, he was very optimistic. He said that Korea could achieve controlled fusion by July 2036. You know, it's really amazing, talking with Koreans, because you are such optimistic people.

We are. We have been optimistic. That is how we are now exporting nuclear power plants, and also building a fusion reactor.



NFRI

Inside the KSTAR tokamak, during its construction in 2007. Dr. Chung credits a U.S.-Korean alliance with improving the successful design for the Korea Superconducting Tokamak Advanced Research.

You know, when we joined this fusion group, people laughed at us, that we didn't have enough expertise. At that time, Hazel O'Leary was the U.S. Department of Energy head, and I was Science Minister of Korea, and we reached an agreement. At that time, the Princeton Plasma Physics Lab had a new design study done. It was called the Tokamak Plasma Experiment, TPX, and I asked: Since the DOE scrapped that plan, whether they could give us the design so that we could improve on it and build a really advanced tokamak machine. So, they agreed, and that's why, for example, David Montgomery, who is an expert on superconducting magnets, came out to Korea to hear what's happening with our superconducting magnet systems.

So it was not, in my opinion, our own work, as much as it was through a U.S.-Korea alliance. And we improved the design, by the way, so it's much better than the TPX. And KSTAR, the Korea Superconducting Tokamak Advanced Research, was the biggest project at the time, in 1995. I had a lot of potshots from the scientific community, that it was a crazy thing we were doing. But our engineers were able to do it, because, for example, we had high vacuum systems. We had other industries which used high vacuum systems, so we borrowed them.

And then we had all kinds of providers of technical services and engineering companies. So together we improved them. That's how KSTAR became the first successful device, and in my opinion, our general technology-based industrialists are ready to tackle KSTAR.

Question: My last question is about space exploration. To achieve a long, stable energy development, the mining of helium-3 (as fusion fuel) from the Moon's surface is necessary. Right now, India and China have space exploration programs, and they are committed to send probes to the Moon, to get samples, and they are developing equipment to mine the Moon. What is their collaboration with the Korean space program?

We do have collaboration. When I was minister in 1995, we had an integrated space research program set up. And the key was, communication satellites plus launching technology. Well, I envisioned a completely Korean effort in propelling this, but in the meantime, the program changed to have Russian technology, so we are having difficulties now.

But we will overcome those difficulties, and we will become actors in space research. I think going to the Moon—there are so many applications of a space visit. That's what we are looking for now....

I am over 70 years old now, and retired. But I am conducting this international nuclear graduate school as a consultant for KEPCO, the Korea Electric Power Corporation.

Question: This is commendable at your age. Lyndon LaRouche, a founding editor of *21st Century* and *Executive Intelligence Review* has put together a team in the United States looking at the challenges of achieving plasma propulsion, the challenges of going to Mars....

You know, I have heard about him. Is he still very active?

Question: He is 88, and will be giving a webcast in the United States....

Ssang-Su Kim: Nuclear Best Solution for the Future

Ssang-Su Kim, President and Chief Executive Officer of the Korea Electric Power Corporation, who spoke at a plenary session of the conference, was asked: "Korea is one of the very active players in the nuclear renaissance. What are your views of the future of nuclear?"

Kim replied:

"Currently the world is confronting the Chinese because of their CO_2 emissions, but renewable energy is not a total solution for that. For CO_2 reduction, nuclear will be one of the best solutions for the future.

"About 20 years ago, we were facing the crisis of the Chernobyl accident. But, after that era, lots of people have developed the technological improvements and advancement of the safety of nuclear. In Korea, we have had no problem in safely operating nuclear power for 30 years. And for Korean safety, the capacity of nuclear power plants for total electricity generation will be increased from 28 percent to more than 40 percent by 2030.

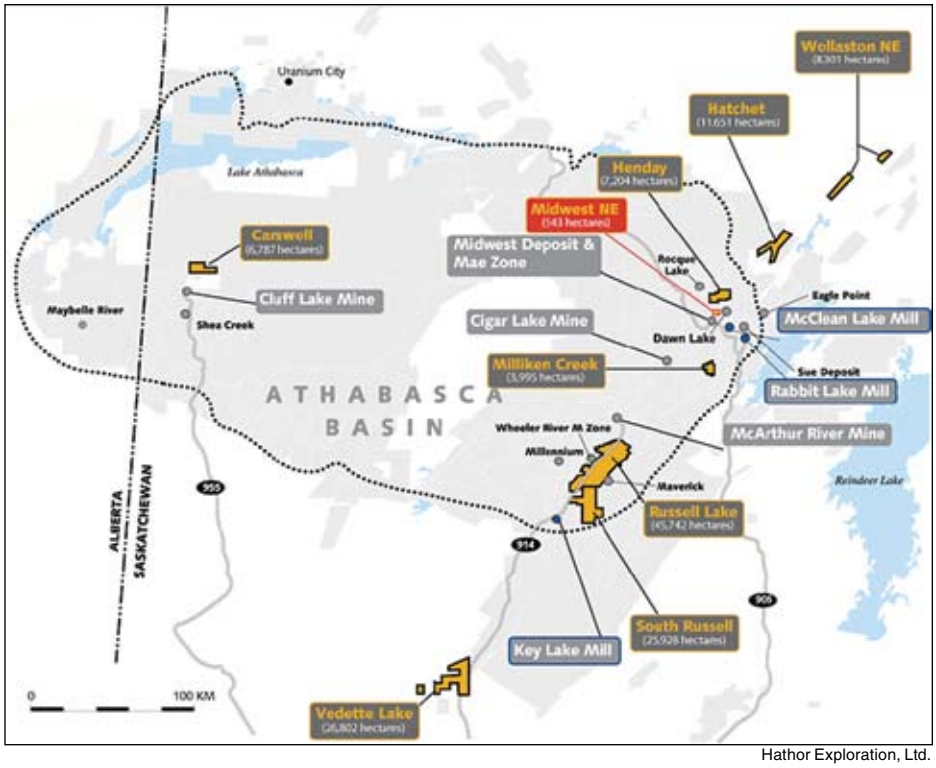
Ilko Dimov

Ssang-Su Kim, President and Chief Executive Officer, Korea Electric Power Corporation (KEPCO): Nuclear is one of the best solutions for the future.

"The world is facing the new adjustment of the nuclear-implementing countries, such as the Middle Eastern countries, which are the world's largest oil exporters, and also South Africa. And in my point of view, the challenging problem we are facing now is that of constructing and operating and managing nuclear power plants safely. To increase and have enough manpower to do that, KEPCO is now starting a nuclear training school, which is one of the first operating schools for nuclear technology and management.

"This particular school is fostering masters degree students with the concept of operating and making nuclear better, from the technological point of view. And we are planning to accept students, 50 percent from Korea, and 50 percent international....

"I sincerely hope that the world-renowned energy companies will have a similar program for fostering the engineers and technological manpower to contribute to the safety of nuclear power plants for the future...."



Hathor Exploration, Ltd.

Map of the Athabasca basin in Saskatchewan, Canada, where Hathor Exploration, Ltd. has found the highest grade (24 percent) of uranium in the world. Above, Saskatchewan Province in Canada.

INTERVIEW: TONY NUNZIATA

World's Richest Uranium Ores Found in Northern Canada

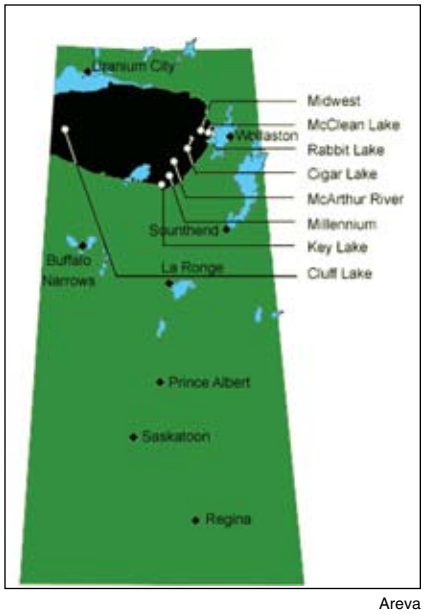
Tony Nunziata represents the uranium mining company Hathor Exploration, Ltd., in its Working Capital Corporation division. He was interviewed by Ilko Dimov, 21st Century *correspondent.*

Question: Please tell us about Canada's uranium production.

We are responsible for almost a quarter of the world's production of uranium. And it all comes from this one area in northern Saskatchewan, called the Athabascan basin. So it is right next to Alberta, and almost right next to the oil sands.

This Athabascan basin encompasses a number of high-grade discoveries and results. The biggest deposit is by Cameco. Cameco, as a single company, is the biggest producer of uranium in the world, through a property called the McArthur River Mine.

We are excited that Hathor, which is located just north of McArthur River, has what we deem is the best discovery in the last 20 years. And why we are excited is that we have found uranium on our original zone, the Roughrider zone, where two years ago, we found that our initial discovery hole, of 12 meters, had just over 5 percentage by weight of uranium oxide—U_3O_8.



Areva

The Athabasca basin in northern Saskatchewan.

Question: Wow!

Since then we have expanded, and advanced that zone to a 200-meter strike length. And, we have come up with some phenomenal grades of uranium, including 23 meters of 24 percent U_3O_8—which is obviously a world class intersection.

Question: Canada is now the largest exporter of uranium in the world, in mining and exporting, right?

Kazakstan has actually taken over as number one. The bottom line is: you've got Kazakstan, Australia, and Africa: Niger and Namibia. They all produce uranium at less than 0.5 percent U_3O_8. But Kazakstan has superseded Canada as overall the biggest producer.

But, the highest grade ore bodies, definitely in the world, the only place you can find high grade, is in Saskatchewan.

Question: Are there other provinces in Canada where we have uranium?

Yes, there are other provinces. Labrador has uranium to a small degree. There have been some issues, against the government, and local governments there have put a moratorium on any uranium exploration.

The only other main area would be

Areva/IAEA

Cigar Lake uranium mine, owned by Cameco, Areva Resources Canada, Idemitsu Canada Resources, and Tepco Resources has run into water problems in its mine shaft.

Quebec, obviously, which is resource rich. They have not only uranium, but quite a host of other mineral resources.

Quebec does have a number of mining companies that are also exploring for uranium. Now. the big key with Quebec, is that they haven't produced uranium for quite a long time. As a matter of fact, there would be an issue there, because economically, there is no infrastructure in place.

In Saskatchewan, in the Athabascan basin, for example, where we are located, we have major infrastructure in place. We actually have a couple of mills within a close distance to where our major project is. The McClean Lake Mill, for example, is a billion-dollar, most modern mill producing facility in the world, for uranium.

So, here in Saskatchewan, all the infrastructure, logistics, and environmental, all the areas of concern, have been in place. Quebec has low-grade uranium there, but in order to fulfill any potential production of uranium, there has to be a major resource, which would make it economically viable to build out infrastructure—which would take a long time.

Here [pointing to map] is an outline of the Athabascan basin, on this eastern side of the Athabascan basin, this corridor here, is a geological trend.

Question: Is that like a fault line?

Yes. For whatever reason, this geological trend hosts all the main discoveries and deposits. That's where Hathor has concentrated and accumulated all our properties and concessions. But if you look at the map, the biggest mine in the world is McArthur River.

There is also Cameco at Cigar Lake, which has water problems; they have been trying to rectify that. There's Midwest Lake Deposit, right next to our discovery, which is AREVA's project. And then down here you have the Wheeler zone of Denniston, and then the Key Lake Mine, which is now depleted, but which also has a mill there. You can see that it's almost a direct trend, within this geological belt that we are exploring for the uranium.

Question: Canada is not enriching uranium, just mining it, unlike France, which is producing nuclear fuel and exporting it to the international market?

Oh, no, we are exporting. A good portion of the uranium from the world's richest mine . . . goes to places like Japan. We do export to other foreign countries.

Question: How many months will you need to get the production of this new discovery going full scale in this area?

It will take time. Right now, because we are in the process of exploring, we still have a lot of drilling to perform to find out the potential size of our discovered area, to make it into a world-class deposit.

After that, obviously for a small company like us, we are talking to major companies that will potentially partner with us, or who knows, maybe even buy us out in due time, in regards to fulfilling their requirements. We are talking to the big majors in the world. We are talking to big power utility companies, out of the Far East where the nuclear renaissance is occurring. Namely, China, India, Korea, Japan.

That's where a lot of the reactors are being built—you know there are 60 nuclear reactors that are being built currently, and most of them are in that neck of the world. Mind you, almost every country in the world is taking some initiative towards nuclear as part of their power.

Question: What does the Canadian government have to say? Because, actually, if you are doing this job, you need support from the Canadian government—a partnership between the governments, the public, the population of Canada—that when you develop these resources, the benefits will stay in Canada. One of the problems we have, with the privatization of major Canadian companies, is that right now, we are becoming a banana republic. A former colony!

I know. Prime Minister Harper just announced recently, that a foreign entity can actually purchase more than 50 percent of a uranium mine in Canada. The Parliament just passed that. You're seeing that happen. Look, last month China just put a billion dollars into Penn West. China is making a major thrust worldwide for resources.

In Canada, you know, we are a resource-rich country and, fortunately (or unfortunately) China is getting involved in all kinds of commodities here in Canada. Is that good or is that bad? Are we looking after our future generations, or are we selling out our resources? We do have a lot of resources.... But, that is a concern.

Question: Can you say something about modernization, efficiency, the new technologies going into the industry?

Here in Canada, we are leading edge when it comes to high grade ore.... We have the best technologies in the world, because of the mill facilities in this area, to be able to properly produce, with efficiency and safety, this high-grade uranium. This is the only place in the world that you can find high-grade uranium. So the logistics are there to be able to properly produce it. It's leading edge.

China, though on the nuclear power front, is building super-reactors. These are amazing next-generation super-generator nuclear power plants that are leading edge. And they are getting a lot of the technology from companies like AREVA and Westinghouse, which are advancing all their technologies.

Fine-Tuning Russia's Floating Nuclear Plants

Peter Shchedrovitskiy is the Deputy Director General of Russia's State Atomic Energy Corporation, Rosatom. He was interviewed by 21st Century *correspondent Ilko Dimov. Shchedrovitsky's comments were translated from the Russian by Rachel Douglas.*

Question: Please tell me about your projects for developing floating nuclear plants. How many of them can you build in the next decade? What are your plans for developing them?

You know, first of all, for some period of time we need to operate the one which was launched in July of this year. We are working on improving the economic efficiency of this type of unit, because it is a prototype, and, as with any prototype unit, there are certain problems related to fine-tuning the technology, to cost, etc.

We are thinking about possibly switching from one type of power plant to another, with different characteristics. Therefore I would not say that we are ready yet to move to large-scale, mass production. But we believe this is one of the projects that aims to shape the global power industry of the future, which needs to be more mobile and more diversified, and needs to be more sensitive to the way consumption is organized at the micro level and to what I called, in my report [to the conference], new paradigms.

Question: What kind of cooperation

On Increased Energy Density with Fission, Fusion

Peter Shchedrovitskiy responded to a question asked at a plenary session by Executive Intelligence Review *correspondent Robert Hux. His comments were translated by Rachel Douglas.*

Hux: I want to get your comments, Mr. Shchedrovitskiy. I was quite stunned, in the previous panel, when the representative from India, the Power Secretary, after describing the reliance in India on coal (I don't know the exact figure, but it was maybe half of the rail grid in India being involved in transporting coal), saying that they are concerned with replacing the old coal plants with these modern coal plants that will lessen carbon dioxide emissions, but saying not a word about the fact of nuclear energy in general, and, in particular, the vast thorium reserves that exist.

Perhaps you can tell us about the relations between Russia and India along the lines of creating small, modular nuclear reactors that can exist over long time frames, perhaps 30 years, and can be used in rural areas, to provide electricity for areas off the power grid.

But, more generally, I was quite stunned, also, not just from him, but the general conference, at the reliance on what I think has to be regarded as a 19th Century dependence on chemical combustion, when we have nuclear technologies available. Could you comment on this concept of energy flux density: What is the difference between reliance on chemical combustion of coal and natural gas, to say nothing of solar or wind, compared to having orders of magnitude, millions-fold increase of energy density, to having something like nuclear fission, and what's our potential with fusion?

Shchedrovitskiy: I heard several questions, and it's a thankless task to answer on behalf of my colleagues, but I'll try to respond to the first question.

Indeed, we cooperate with India on building thermal reactors. We have agreement in principle on building up to 16 nuclear power plant units.

At the same time, India has a powerful, well-developed strategy for the development of nuclear power, which provides for creating alongside the ongoing construction of thermal reactors a set of breeder reactors. The first of them is slated to come on line in 2011. And then, they plan to move to the thorium cycle.

That's what I can say about our Indian colleagues, but of course it would be better to ask them directly.

As for increasing efficiency, yes, it is our view that thermal reactors are more efficient, with respect to fuel supplies, than using coal—as measured in electricity output per standard unit of fuel.

Fast breeder reactors are even more efficient than thermal reactors. Something like 100 times more efficient.

As for thermonuclear fusion, the increased efficiency indeed can be expressed by factors of hundreds of thousands, or even millions, compared with breeder reactors. But, I would like to say that fusion is definitely something for the more remote future, because in the ITER project, the first plasma is supposed to be in 2018, and the full cycle in 2028, which means we will unlikely be able to move to designing an industrial unit of this type, even with international cooperation, any earlier than 2030.

Those are the existing plans for the growth of efficiency per standard unit of fuel, through a sequence of changing technological approaches.

would you like to have with the United States?

With the United States, we are currently negotiating in the area of general infrastructure projects, i. e., on global support for nuclear power through elements of infrastructure which provide developing countries access to these technologies, without violating the non-proliferation system. And, second, I think we will arrive at a certain cooperation in science, particularly as related to breeder reactors.

Rosatom

Rosatom's design for its first floating nuclear power plant.

Question: Lyndon LaRouche has proposed economic cooperation among Russia, the United States, India, and China to create a new financial system with fixed exchange rates. Because we have problems—speculation on energy prices is a factor that wrecks development. Can you say something about the potential for stabilizing the international financial system?

I am not a specialist on the financial system. I have read LaRouche's books, but, frankly speaking, I prefer to speak about things in my area of competence.

INTERVIEW: JOHANNES PENZKOFER

On Joint Russian Development Projects: 'We Are Sitting in One Boat'

Johannes Penzkofer, a vice president of the Russian engineering company, GCE Energy Consulting Group, was interviewed by 21st Century *correspondent Ilko Dimov. This is an abridged transcript of the interview.*

Question: Since October of last year, the Chinese and Russian governments signed a strategic agreement for collaboration in the development of the Far East, including access to raw materials, building high speed rail, and development of nuclear energy. And Russia is building a breeder reactor right now in China. What is your long-term view? What do you see as areas where you need collaboration with Canada or the United States? What are the areas where we can design joint projects to work together?

I think, as we are here at the World Energy Congress, this is a very important topic. We can collaborate with all, or let's say, with the four countries that you have talked about: China, Russia, the U.S., and Canada. Especially on the technical and the equipment side, there is very much knowledge in Canada, and the U.S., and in Canada, especially with hydro energy and hydroelectric. This is what we really have to share, and use, to create a more efficient use of energy in the industry.

Question: One of the traditional problems in the Soviet Union, and in Russia, has been that things move slowly. You start building something, and it takes centuries to be accomplished. Now, there is a very surprising speedup: the modernization of the rail system. Prime Minister Putin said in a recent report, "We just doubled the rail system in Russia!" Wow, that's impressive! How were you able to achieve this success?

It's typical for Russia, that, if they make a commitment, they really do everything to fulfill this. And when the government said, "this is our strategy, our plan," the whole country was trying to follow this, and this is how it was was achieved.

Question: One of the projects which has existed since the strategic collaboration between Czar Alexander II and Abraham Lincoln, is the development of Siberia and of Alaska. Now we have the potential of building the Bering Strait link. We are working in the United States towards this project, and we would like to make it a reality in the visible future, in 10 years. Is there the political will in the Russian government, the friendly hands, to get people on the ground to start moving in this direction?

I think, frankly speaking about Putin and [President] Medvedev, that both of them are, let's say, practical people. So, they are realistic people. And I think they are very open to all kinds of alliances and partnerships, which will bring us forward. So, I think this can be taken for granted that, the hand is open.

Question: With the development of fusion energy over the next 20 to 25 years, the fuel for our economies will be helium-3, the isotope of helium, which will be mined from the surface of the Moon. And without collaboration in the life sciences, this will be very difficult. Because, we know that Russia, with its long-term space exploration, has had the longest stays in space.

And with the ISS, the International Space Station.

Question: Yes, your experience is maybe 10 or 15 years ahead of us in the life sciences, and we are looking into areas where we can collaborate with this. . . .

This collaboration, I agree with you, only can be on, really a global basis. Let's say, the big nations have to work on this together, because it's one of the big future questions of mankind. And I agree, neither Americans, Chinese, or Russians can fulfill this question themselves, or alone. . . .

Question: I have a couple of economic questions. Since 2007, when the economic derivatives market exploded, we have had decision by the Bush Administration, and a commitment by the Obama Administration as well, to commit the U.S. government and the Federal Reserve to a bailout of the U.S. banks—already $26 trillion. And I know this is a concern of the Russian government as well, because if the dollar collapses you will lose your savings. So, the belief that you are rich because you have "money," will disappear; you are going to discover that you don't have anything.

It could be a real implosion!

Question: We have had serious economic crises since the Versailles treaty. . . . We had a successful solution by the Bretton Woods conference, which established a fixed-exchange rate system, capital controls, exchange controls, stable raw material prices, which, until 1974, were determined by governments. We are organizing now internationally, to reestablish a fixed exchange rate. And Russia is an essential player—

Of course.

Question: What do you think about the prospect for a conference, as we have proposed, to deal with these economic questions?

I think, it is a need, and I think that Russia will play an active role in this conference, and will collaborate in this discussion. Because, as you said before, it is in our common interest. And, it's about keeping the world going. I mean, we are all in the same boat in that. That's another side of globalization. You can't divide from the rest, or say: "It's not my ball game." It's the same for the Chinese, for the Russians, the Europeans, and the Americans. So, we are sitting in one boat.

INTERVIEW: BERNARD BIGOT

We Need International Cooperation for Nuclear Power


CEA

Bernard Bigot, is Chairman of the French Atomic Energy Commission (Commissariat à l'Energie Atomique), CEA. He was interviewed by 21st Century *correspondent Ilko Dimov, and this is an abridged transcript. The interview was translated from the French by Matthew Ehret-Kump.*

Question: In France, we are associated with Jacques Cheminade, who has just announced his candidacy for the next Presidential elections.

I know him well.

Question: One of Mr. Cheminade's programs is based upon nuclear development, using the expertise of France with nuclear and great projects in making the nation a motor for global development, and returning France to de Gaulle's vision, with nations collaborating together, not competing. . . . But there is an absence of credit for the development of industry and, in particular, science. What are your thoughts about what is necessary for providing the financing and vision required to accomplish the necessary miracle of rebuilding the world?

Listen, I think that with the problems which are occupying us today, here, in Montreal, that is to say, energy, there are no solutions if we do not develop solidarity. Resources are, as we know, limited. They are not necessarily equally distributed. There isn't one legitimate reason why a country which has easy access to one or another resource, should not share it with the rest of the world. Otherwise, we will move towards tension, we will move towards conflicts, without anyone benefiting globally. No one will win.

Thus, we should try to build mechanisms which maximize solidarity. So, the first point which you bring up, is the access to financing. *Voilà*: It's clear as we saw earlier with the speaker from the Congo, and we see it in many other countries. One of the major handicaps to the development of energy production to the scale many countries need, is the obstacle of financing, that is to say, the power to obtain financial channels, to obtain loans at reasonable rates. This is the chief obstacle.

For me, this is a first priority. It is absurd, for example, in the domain of nuclear, that the World Bank cannot contribute anything to a country which

desires to go in that direction. On the other hand, the World Bank would contribute if there is an installation that will consume coal.

That runs contrary to the global interest. We should respect this possibility to diversify. I'm not saying that loans should not be offered for coal as well, if we develop it alongside of carbon-sequestering technologies. But why exclude one or another technologies? That is the first point.

The second point involves access to technology. It is clear that many countries do not have the capacity to conduct what we call research and development, in order to make their own demonstrations. We must, therefore, try to develop large international programs with access to intellectual property.

CEA

CEA chairman Bernard Bigot: It's absurd that the World Bank doesn't fund nuclear projects.

The challenge in energy, is not that an industry will lose its power to sell and produce a technology, simply because a demonstration is created which proves that this or that technology is feasible. There is a step which is an industrial competence, which is not in the R&D. Thus, in everything we call research and development upstream, up to the point of demonstration, we should move more towards international cooperation.

The last stage is training. It is clear that all of these systems are complex. It can't work if you don't have people who are well trained, who have access to knowledge, and the experience of working with this sort of large-scale equipment.

Thus, these are the three stages which for me, are necessary, and I see no obstacles which should stop us from going in this direction, and which France in her place may take favorable initiatives for this process.

Question: Can you give us a sense of the international collaboration in which France is involved today, in terms of promoting and constructing nuclear reactors?

We are engaged, in particular, in what is called the Gen4Forum. That is, the Generation 4 Forum, in which a dozen large countries are re-uniting today and in which we have made common programs for researching materials, designs, and security, in order to effectively advance the development of nuclear energy.

So, there are Japan, Korea, Argentina, Brazil—there is an assembly of countries, some very advanced, and others much less so, who are sharing knowledge. Honestly, I think that it's a good example of what it is possible to accomplish. Simply, it must be done with continuity, and it is true that some countries, such as the United States, which were once a very active driver in this process, today, are a little behind.

World Nuclear Association

Training of younger nuclear workers is essential, Bigot said. Here, participants in the 2009 World Nuclear University Summer Institute which trains promising young nuclear professionals from around the world.

Question: In reality, the United States does not have the capacity to produce nuclear reactors today.

There you go. But that does not diminish the competence which they have developed. It is the greatest park in the world and at one moment or another, they will be obliged to return to it.

Question: Our publication is widely read by young people who are looking for leaders who represent these solutions and who will transform these dreams into reality. What can you say to these youth between the ages of 20-30, who have lived through the last 15 years in pessimism?

I think that we must share with these youth, the following idea: The last 50 years have seen some technical and economic advances, but we have not overcome many challenges which are still ahead of us. And my vision is that these youth must invest themselves in science, in technology, because my deep conviction is that this is the most common language on the planet.

There isn't a boundary for science. Science reproduces results, in conducting the same demonstration. It is to lift ourselves to that level, that will perhaps be the determining factor for economic development. I believe that the idea of contributing in this way, will fuel their enthusiasm and their conviction, and we need these youth to invest themselves in order to help us.

Question: Dr. G.S. Lee has made the prediction that we would have fusion by July 2036 [See interview, *21st Century*, Winter 2009-2010.] What is your prognosis, your vision?

I am not as precise as Dr. G.S. Lee, who is a very formidable man. For me, I think that accord-

D. Calma/IAEA

"There isn't a boundary for science." Here international flags at the International Atomic Energy Agency headquarters in Vienna.

ing to the program which we have, in 2026-2027, we will have the first experiment which demonstrates that we are capable of producing a balance of positive fusion energy through heated plasma.

If this stage is realized, in 2026-2027, I think effectively at that moment, we will need a decade to explore superior conditions, to optimize the process as well as the massive production of fusion energy which will benefit the planet. That is to say, the first reactors of several thousand megawatts could be installed by 2075.

This might seem far, but it isn't really, if you reflect on the development of energy from our use of coal, to petrol, to gas. We are dealing with scales of time in this magnitude. It could accelerate a bit if nations worked all together, but I don't believe that we can take shortcuts, and it would be formidable, if we achieve this demonstration, and then find that it will give us abundant resources not just for 100 years, 1,000 years, but rather hundreds of thousands of years.

There will be a limited impact on the environment, on the climate, on the limitation of resources, and even on the danger that this could represent. It is a challenge that merits this investment, but don't be impatient. There is a step still to go, but we are on the right track. Progress is moving in the right direction. In my view, it can't be solved in the blink of an eye, so I don't know if it will be in July 2036, but why not?

The Deadly Cost of Malaria —And Not Using DDT

by Marjorie Mazel Hecht

Three Billion And Counting
Los Angeles: Frogbite Productions, 2010
DVD, 142 min., Check www.threebillionandcounting.com for availability

This is an excellent documentary on malaria and DDT, exposing how a simple program for spraying with DDT could prevent nearly a million deaths and hundreds of millions of new infections from malaria every year, and put no one in danger. The film would be flawless, if it had only gone one step further, to show that the banning of DDT is not just "how it is," but a conscious piece of the British Empire's intention to kill three-quarters of the world's population.

The film is dedicated to the memory of Dr. J. Gordon Edwards, the San Jose State University entomologist who battled for years to bring the truth of DDT and its life-saving capabilities to the public. That alone should be enough to recommend it for readers of *21st Century,* who are familiar with Edwards's many articles on malaria and DDT. But there is much more to recommend this film, even for those, like myself, who have followed the fight for DDT for decades.

The Malaria Journey

D. Rutledge Taylor, a young physician who specializes in preventive medicine, wrote and directed the film. His malaria journey began when a patient asked him in 2004 how to protect against West Nile virus. In researching the answer, he was startled to read in a *Nature* magazine article that nearly half a billion people were getting infected with malaria every year. How could that be, in this day and age, he wondered? And then, when he asked a friend, Dr. Art Robinson, about malaria, he was shocked to hear that DDT use can prevent malaria, but was deliberately withheld from use. "Withdrawal of technology" and "technological genocide" were Robinson's words. This couldn't be so, Rutledge thought.

Three Billion and Counting

An African baby with cerebral malaria. Every 30 seconds, one child in Africa dies of malaria.

And so began Rutledge's saga. His friend challenged him to find out for himself about malaria and DDT, and Rutledge set out to do that, with the help of a film producer friend, Helene Udy, and a camera team. As Udy said in the beginning, all she knew about DDT was that it was "bad," and she wanted to find out the truth.

The film follows their journey to several African and Asian countries, filming interviews, and to Washington, D.C., for more interviews and document collection.

The images and voices of malaria victims and malaria control officials and physicians are unsettling, indelibly imprinting on your mind the staggering numbers of people who are poor, and sick, and who die, simply for lack of resources, including DDT. Some of the most telling images, however, are those of the malaria control officials who are visibly afraid to voice their opinion on DDT use in front of the camera. When Rutledge asked the head of the Division of Malaria Control in Kenya if he would use DDT to save lives, the official answered, "I cannot provide a straightforward answer to that."

Their obvious fear belies those self-righteous DDT critics who claim that DDT was "never banned in Africa," when the reality is that NGO and government aid programs (most prominently U.S. AID) prohibited funding any program that used DDT. Officials of those programs that now use DDT made it clear to the Rutledge team that they could do this only because they did not depend on outside funding.

Killer Lies

The killer environmentalist lies came out at their most extreme in the interview with John Ken Lukyamuzi in Uganda, who has made a name for himself as a legislator and activist attacking DDT and delaying Uganda's house-spraying program. He is shown inciting a crowd to "get your machete" when the spraymen come to your house. "You will not be responsible in the eyes of God." When asked by Rutledge about the 350 people who die of malaria every day in Uganda, he said he didn't believe it. Pressed further, Lukyamuzi said, "let one die if one has to die."

There is a lot to learn in the film, and one wishes it would be required viewing for all the knee-jerk anti-DDT true believers, especially those who think there are more "friendly" alternatives for stopping malaria.

For example, it is politically correct to champion bednets as the answer to malaria in Africa, despite the fact that the Roll Back Malaria effort, focussed on bednets, has failed to achieve any roll back in malaria whatsoever. This failure

Three Billion and Counting

D. Rutledge Taylor, who wrote and directed the film.

is fully admitted by the bednet promoters. The UNICEF malaria project officer in Mozambique, where the main funding for UNICEF is to distribute bednets, stated flatly, "People who use nets alone will always get malaria."

As for the alleged "dangers" of DDT, in addition to many interviews with scientists and others, the Rutledge team visited the DDT manufacturing plant in Cochin, India, the Hindustani Chemical Company. Its chairman, Harry Kumar, told Rutledge that DDT has prevented 500 million deaths—"not a small number." He emphasized that the government of India pays for the DDT production at a price that the government fixes. The plant makes no money from DDT production, he said, but does it as a social service. Kumar stressed that in the plant's 50 years of operation, there have been hundreds of workers and not a single case of a problem with DDT.

Another Indian public health official stated that India doesn't care what the industrialized countries think about DDT. They use it because it's effective, with no negative consequences. Where it isn't used, in some remote areas of India, there is malaria and people die.

Washington: More Lies

After 40 days travelling through Asia and Africa, the Rutledge team trekked to Washington, D.C., to answer the question of why EPA administrator William Ruckelshaus banned DDT in 1972, even though the EPA's own hearing on DDT ruled that it should not be banned. Rutledge found the 9,000-plus pages of testimony from those hearings in the National Archives, and photocopied every page.* There he found ample scientific evidence that DDT causes no human harm.

Rutledge's attempt to ask a U.S. environmental organization about DDT is met with a screechy: "DDT has never stopped malaria. It's a myth." This phone interchange is very brief, but conveys the "I don't care about the truth" hysteria of the Malthusian opposition to DDT.

The film substantiates in many ways that population control is the reason that DDT was banned and is not used more widely in malarial countries. But as superb as it is, "Three Billion and Counting" stays within the confines of the Empire's left vs. right, liberal vs. conservative, established battleground, which continues to assure the status quo.

To win this fight, the knife must be thrust into the heart of that Empire, whose leading representatives, Prince Philip and the Nazi Prince Bernhard, founded the World Wildlife Fund, and the environmentalist movement, with the intention of perpetuating genocide. Telling the whole truth may not assure accolades or Academy Awards, but it would give the population a chance to understand the brutal intention behind environmentalism.

On the Mark

The film is right on the mark, however, documenting that the ban on DDT is genocide. This is backed up by interviews with a score of scientists and others who have continued to fight for DDT, leaving no doubt that DDT was banned for political, not scientific, reasons—and that this was done deliberately. Each of the common anti-DDT objections is answered one by one, reinforcing the points made in the interviews.

Three Billion and Counting

Above: National Archives boxes containing the 9,000-page transcript of the 1972 EPA hearings on DDT. EPA administrator William Ruckelshaus neither attended the hearings nor read the transcript. He made the decision to ban DDT, against the advice of the EPA hearing administrator.

Left: EPA hearing examiner Edmund Sweeney (center) in a film clip from the 1972 hearings on DDT.

Most touching for me, is the dedication at the end of the film to a dear friend, Dr. J. Gordon Edwards. He fought the lies about DDT through great personal sacrifice, and the film is a fitting tribute to his memory.

There are many zingers in the film, that will surprise even the DDT literate. But I will leave it to you, readers, to find out by seeing the film, buying the DVD when it becomes available, and getting this important documentary shown to schools and community groups.

* The summary statement of the hearing administrator can be read on the *21st Century* website.

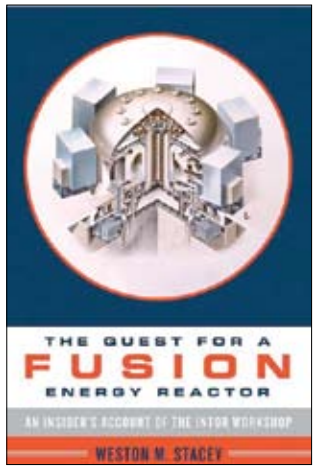
Stuart Lewis/EIRNS

Entomologist J. Gordon Edwards speaking at the National Press Club in May 1992, at a press conference commemorating the 20th anniversary of Ruckelshaus's decision to ban DDT for "political" reasons.

Fusion's Long Road to ITER

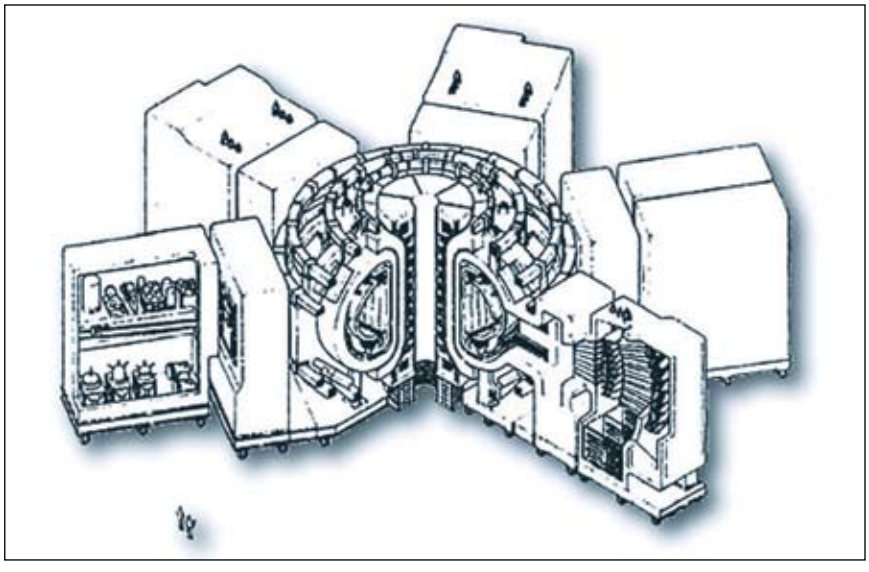
by Stephen O. Dean

The Quest for a Fusion Reactor: An Insider's Account of the INTOR Workshop
by Weston M. Stacey
New York: Oxford University Press, 2010
Hardcover: 188 pp., $24.95



The Arab oil embargo (October 1973-March 1974) caused many countries to seriously question their dependence on Middle East oil as a dominant energy source. In the United States, this took the form of rapidly increased funding for research and development of alternative energy options. At the United States Atomic Energy Commission, the U.S. fusion program (then called Controlled Thermonuclear Research), under the direction of Robert L. Hirsch, was one of the beneficiaries.

When Hirsch took the helm of the fusion program in early 1972, he wanted to move the fusion program from research into development and deployment as rapidly as possible. As director of the largest of three divisions reporting to Hirsch, I prepared a decision tree, dated October 1972, describing a plan that included operation of a Physics Test Reactor by 1984, an Experimental Power Reactor by 1991, and a fusion power Demonstration Plant by the year 2000.



A 1980s design study, for the Intor Experimental Tokamak Reactor.

When the oil crisis hit, fusion funding was increased from its FY 1973 level of $40 million to $332 million in FY 1978 to a high of $469 million in FY 1984. The Physics Test Reactor, which we named the Tokamak Fusion Test Reactor (TFTR), was authorized in the FY 1976 budget, and began operations in 1983. A similar facility, the Joint European Torus (JET), began operations also about that time.

While these physics test reactors were under construction, attention began to be given to the conceptual designs of the Experimental Power Reactor (EPR) and fusion power plants. In the mid-1970s, author Weston Stacey led a team at Ar-

gonne National Laboratory that produced conceptual designs of two EPRs. Other EPR designs were carried out by Mike Roberts at Oak Ridge National Laboratory and by Charlie Baker at General Atomics. Stacey's book traces the history of the international effort to design an EPR, starting in 1978 under the auspices of the United Nations International Atomic Energy Agency (IAEA). That EPR was given the name INTOR, an acronym for INternational TOkamak Reactor.

INTOR eventually merged into ITER (International Thermonuclear Experimental Reactor), now under construction in France as an international venture, but not scheduled for operation until 2019. Stacey's book provides a compelling narrative on how the schedule for the EPR started to slip and is now 30 years later than the 1990 date hoped for in 1972.

Weston M. Stacey, more widely known as Bill, is Callaway Regents Professor of Nuclear Engineering at Georgia Institute of Technology. As leader of the U.S. INTOR team, and vice chair of the international group responsible for the INTOR effort (1978-1988), he is well qualified to write this account, and he does so in an authoritative, thorough, engaging, and candid manner.

Stacey kept meticulous notes of his interactions with both the technical team and government officials. He pulls no punches in describing resistance on the part of some to the study and changes in the political landscape. National interests and policies frequently came in conflict with the desire of the INTOR team to move the project expeditiously from design and R&D to construction.

Nevertheless, there is no denying that, without the INTOR work, collaboration on the design and construction of a fusion engineering test reactor would likely not have been a credible proposal to lay on the table when President Reagan and USSR Secretary Gorbachev agreed to collaborate on fusion during their Summit Meeting in Geneva in 1985.

Wilson photo collection, Harvard University Physics Department

Evgenii Velikhov (left) with Edward Teller and Richard Wilson, at the Erice meeting in 1983. Velikhov, the head of the Soviet fusion program, proposed the INTOR study to the IAEA and continued to support its construction.

A Collaborative Effort

The INTOR study was a collaborative effort among the United States, Japan, Soviet Union, and Europe, under the auspices of the IAEA. The chairman was Sigeru Mori from Japan, with Stacey as vice chair. But if there is a hero in this account, it is Evgenii Velikhov, head of the Soviet fusion program, who proposed the INTOR study to the IAEA in the first place, and who steadfastly expressed the support of the Soviet Union for INTOR construction, when the other parties were giving mixed messages, or having financial crises, within their own government programs. It was Velikhov who brought the collaboration to the attention of Secretary Gorbachev, in advance of the 1985 Summit Meeting with President Reagan.

The goal of the INTOR study was to assess the readiness of the world's fusion programs to undertake the design and construction of the first experimental fusion energy reactor, to define the research and development that would be necessary to do so, to develop a design concept for such a device, and to identify and analyze critical technical issues that would have to be overcome.

Stacey's book describes both the detailed technical evolution of the design and the administrative and political issues that plagued the project. A major issue throughout was the ambivalence among the heads of the fusion programs in the various countries about whether their national program goals would be better served by focussing on construction of national EPRs, rather than an international project. This ambivalence was especially characteristic of the U.S. leadership, according to Stacey.

The INTOR Workshop was launched in November 1978. By October 1979, the team had come up with rough estimates of the cost of an EPR, ranging from about $1.5 billion (E.U. and U.S.) to $2.3 billion (Japan). In a 650-page report, the group also concluded that it was scientifically and technologically feasible to undertake the construction of INTOR initially, to operate about 1990, provided that the supporting R&D effort would be expanded immediately to provide an adequate database within the next few years in a number of important areas.

Although the leaders of the national fusion programs endorsed the findings, it was clear that they were not prepared to undertake commitment to an international construction project. The INTOR design continued to be refined, until the ITER project was launched (also as a design study) in 1988.

The goals of the U.S. fusion program, to operate an EPR by 1990 and a demonstration power plant by 2000 continued to look possible throughout the 1970s, culminating in the passage in October 1980 by the U.S. Congress of the Magnetic Fusion Energy Engineering Act of 1980, which made these goals national policy.

A Major Downshift

Stacey's book describes the major change in U.S. energy policy following the election of Ronald Reagan as U.S. President in November 1980. He notes Congressional testimony in the Spring of 1982 describing the new U.S. fusion policy as to develop the database for fusion, allocating to industry the demonstration of fusion as an energy source. This policy derailed the goals set in 1972 as codified

in the Magnetic Fusion Energy Engineering Act of 1980.

While ITER is now aimed at many of the original EPR goals as an international venture, a timetable for a demonstration power plant remains obscure.

In 1988, the ITER venture began. Originally, at the 1985 Reagan-Gorbachev Summit Meeting, it appeared that the two had agreed on a relatively rapid process leading to construction. As it turned out, however, construction did not begin in earnest until 2009, more than 20 years later.

Stacey's history ends in 1988, with the handoff of the INTOR design work to the new ITER team. Many of the INTOR participants joined the ITER design team, including Ken Tomabechi (Japan), who became the first ITER design team director. The 20-year history of ITER preparations (1988-2009) appears in secondhand reports in the trade press and elsewhere, but a candid insider's history, such as the one Stacey has provided for INTOR, remains to be written.

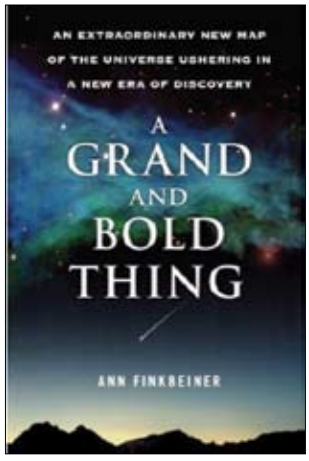
I highly recommend this book to all those involved in fusion research, administration, and policy. It is well written, in an engaging style, while also being unusually candid and thorough. Well-done and thanks, Bill Stacey.

Stephen O. Dean is the president of Fusion Power Associates.

The Story of the Sloan Digital Sky Survey

by Laurence Hecht

A Grand and Bold Thing: An Extraordinary New Map of the Universe Ushering in a New Era of Discovery
Ann Finkbeiner
New York: Free Press, 2010
Hardcover, 223 pp., $27.00



The author devoted three or more years to interviewing the participants and doing the research to document this great achievement in observational astronomy, which is now accessible to all on the Internet. Some of the nation's leading astronomers and an army of code writers, many of them graduate and undergraduate students in the field, put together the system for utilizing a 2.5 meter (98-inch) telescope at Apache Point, N.M. to make the largest sky survey ever assembled, including more than a million galaxies.

My disappointment was not in the description of how the project came to be, but in the interpretation of its results, which sticks a bit too obediently to standard cosmological assumptions. The modern, zipped-up style of science writing also proves a distraction. Is this really what it takes to sell books these days, or are the writers merely degrading themselves in pursuit of a will-o'-the-wisp of public approval?

The Sloan survey was the brainchild of James Gunn, an accomplished astronomer, cosmologist, and master instrument designer, who conceived it in the 1970s and spent most of the 1990s helping to bring it to fruition. Fermilab, Princeton, the University of Chicago, and a number of other leading universities participated, with initial funding from the Sloan Foundation.

A Network of Superclusters

The photographs and spectrographic data have contributed to our understanding of the structure of the universe, at least in the visual spectrum. When combined with a smaller visual survey, 2dF, run out Cambridge University, the maps showed an ordering to the galaxies that had not been known before.

Galaxies form in clusters which are part of superclusters. These superclusters, in turn, are "not isolated in clumps but are parts of a universal network, filaments of lights that are denser or thinner and sprawl over sheets that fold themselves around dark voids.... It looks like solidified lava, or a sponge, or medically imaged tissue.... It is biological, geological, natural—just the way you would expect the universe to look."

Google Sky and WikiSky utilize the Sloan maps for the approximately one-quarter of the celestial sphere that they cover, and fill in the rest of the sky with other less intensive surveys. WikiSky attempts to integrate the view of the sky in different wavelengths, including the ultraviolet and infrared. An International Virtual Observatory Alliance is attempting to oversee the production of detailed multi-wavelength archives, including the gamma ray, X-ray, ultraviolet, visual, and infrared spectra.

I found Chapter 7, The Virtual Observatory, to be the most fun. Part of the unusual agreement in the project had been that after a year, all data would go into the public domain, via the Internet. That decision has already revolutionized the field, in which access to telescopes and proprietary nature of data had heretofore been a severe restriction. Today, anyone can access the Sloan digital archive, simply by searching for SkyServer on the Internet. Once there, a huge wealth of information is available to any who wish to learn how to use it.

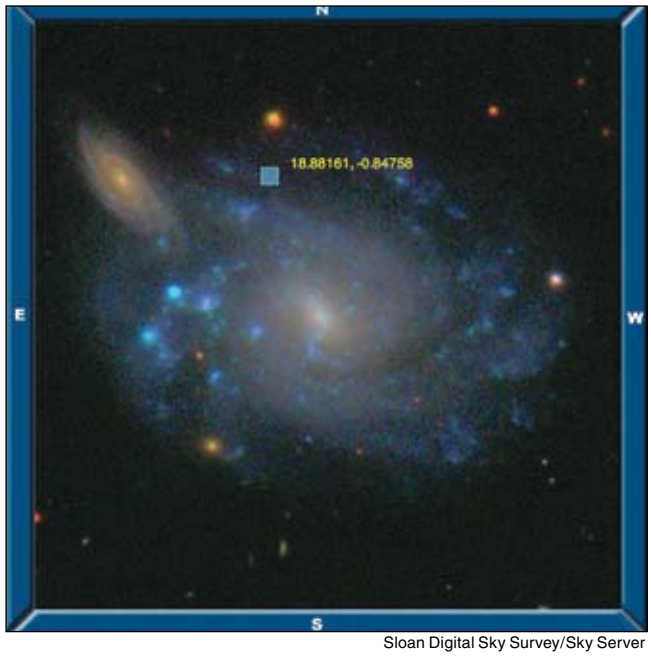
There have been 713 million hits on the Sloan archive since the first public release of data in June 2001; currently it has 60,000 to 70,000 different users a month, many times more than the number of professional astronomers in the world. Some of these are volunteers who are using the Sloan archive to participate in a project known as the Galaxy Zoo, to help classify the millions of galaxies photographed by the Sloan Survey. Computers are not as good as humans at the complex shape recognition and interpretation required for this. There are 272,000 "zooites," as the participants in the Galaxy Zoo project call themselves.

Dusty Beginnings

The idea of enlisting the public in such programs originated with a NASA project called Stardust@Home, which drew in 24,000 people to examine Internet images of 40 million dust grains collected from a comet's tail and brought back to Earth. The idea was to see if any of the grains looked unusual and might have come from outside the Solar System.

In 2007, two Oxford University astronomers needed help in examining a sample of blue elliptical galaxies to determine their shape. They guessed that if 24,000 people, "dusties" as they were known, would look at grains of comet dust, it should be possible to find some Internet users to look at the beautiful galaxy photographs in the Sloan archive.

Combining with a small group of astronomers who needed shape classification of galaxies, they created the website Galaxy Zoo, expecting that in three years they might get 10 classifications per galaxy. Within a few hours of a July 2007 3-minute appearance on BBC Today, Galaxy Zoo had received 10,000 emails, most from people complaining that they couldn't get to the website. The server had of course crashed. After assigning the site to a new computer, by the end of the week, the 50-million classifications which had been projected to take 3 years, had been completed by 150,000 volunteers.



Sloan Digital Sky Survey/Sky Server

NGC 450 and a companion, two of the many galaxies available for exploration on the Sky Survey. Although these two galaxies appear to form a pair, they are actually at different distances; the smaller, fainter object is 7 times farther away.

Completely Conventional

The disappointing aspect of the book is the complete acceptance of the conventional view of cosmology. For example, if red shift is not simply a measure of recessional velocity, but as Halton Arp's work indicates, may be an intrinsic feature of certain formations which lie at various distances from us, then the entire map is off.

The same is true if expansion theory, which supposes that higher velocities mean greater distance, is mistaken. And there is the problematic "Big Bang."

Reprising the standard accepted theory in any field, no matter how popularly, does not really serve to educate the public, but only to indoctrinate it. What is interesting, and truly instructive, is what contradicts it, for there the new discoveries lie. In this regard, the recounting of Jim Gunn's thoughts is provocative. Ann Finkbeiner is well-versed in the conclusions of modern cosmology, but more attention to the underlying assumptions which determine how we know what we think we know, would be welcome.

The Dam That Harnessed the Colorado River To Do 'Man's Will and Man's Work'

by Glenn Mesaros

Colossus: Hoover Dam and the Making of the American Century
by Michael Hiltzik
New York: Free Press, 2010
Hardcover, 408 pp., $30.00

Seventy-five years ago, on Sept. 30, 1935, President Franklin D. Roosevelt dedicated the great Hoover Dam, speaking to millions of Americans via a radio broadcast, and thousands on site:

"This morning I came, I saw, and I was conquered as everyone would be who sees for the first time this great feat of mankind.

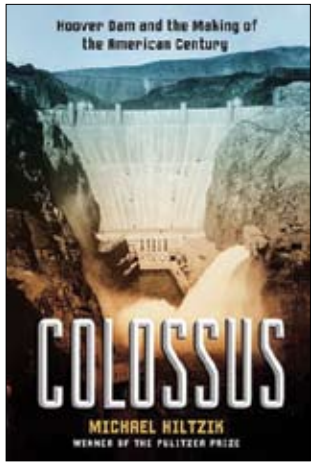
"Ten years ago the place where we are gathered was an unpeopled, forbidding desert.... We are here to celebrate the completion of the greatest dam in the world, rising 726 feet ... and altering the geography of a whole region; to see the creation of the largest artificial lake in the world ... with enough water to cover the State of Connecticut to a depth of ten feet, and to see nearing completion a power house ... which can continuously supply 1,835,000 horsepower of electric energy. All these dimensions are superlative.

"While we do all this, we give actual work to the unemployed and at the same time we add to the wealth and assets of the Nation. These efforts meet with the approval of the people of the Nation.

"Labor makes wealth. The use of material makes wealth. To employ workers and materials, when private employment has failed, is to translate into great national possessions the energy that otherwise would be wasted. Boulder Dam is a splendid symbol. The mighty waters of the Colorado were running unused to the sea. Today we translate them into a great national possession."

Author Michael Hiltzik tells us much about the great dam, initially known as Boulder Dam, in *Colossus,* but there is too much that he leaves out, most egregiously, the cultural optimism and revival of the human spirit that Roosevelt's New Deal projects had on the American population. Hiltzik's one attempt to show the social impact on Americans of the FDR explosion of infrastructural development, was to cite the inaugural issue of *Life* magazine, in November 1936, which depicted the huge spillway gates of the Montana Fort Peck Dam as "a celebration of mass ... and grandeur were seen as counterbalancing the meanness and constraints of the Great Depression."

Fortunately, the history of the great dam can speak for itself to convey to today's generation the scope and importance of the project.



U.S. Bureau of Reclamation

Hoover Dam at work.

An Historic Appropriation

On Dec. 28, 1928, the tight-fisted, and outgoing President, Calvin Coolidge, signed the largest single appropriation in the history of the U.S. Congress: $165 million for construction of a 726-foot-high arch gravity dam and power plant, at Black Canyon, on the Colorado River border between Nevada and Arizona.

Located about 30 miles from a nondescript town called Las Vegas, the site had been repeatedly surveyed by the U.S. Reclamation Service as far back as 1900. Not officially called the Hoover Dam until 1947, the location just fit the then farthest extent of transmission power lines to the energy-hungry city of Los Angeles, which signed up for most of the power to be consumed.

President Herbert Hoover received the honor of the Dam's namesake because he toiled for years in bringing seven southwestern states

U.S. Bureau of Reclamation

Franklin D. Roosevelt dedicating the Hoover Dam, Sept. 30, 1935: "This morning I came, I saw, and I was conquered as everyone would be who sees for the first time this great feat of mankind."

into a Colorado River Compact, signed in November 1922, which distributed the water and power rights. Congress then dallied another six years before appropriating the monies, at the behest of Republican Senator Hiram Johnson (R-Cal.) and Congressman Phil Swing (R-Cal.), mostly because "Silent Cal" Coolidge did not like to spend money.

Congress finally pushed Coolidge to do it after the 1927 Mississippi Flood devastated New Orleans, and a bipartisan coalition demanded flood control projects on a nationwide basis, which became the Flood Control Act of 1928. Engineer Hoover, at the time, did not even promote a high dam on the Colorado, but just asked for 13 smaller dams, and irrigation canals.

The political obstacles were many. President Coolidge had demanded that various utilities sign up for power consumption totalling $327 million over 50 years to pay for the Great Dam. The Wall

Roosevelt and Hoover Dam

One of the stories *not* included in *Colossus* is the Sept. 11, 1936, event at Constitution Hall in Washington, D.C., where President Roosevelt addressed 3,000 delegates at the 3rd World Power Conference, and 2nd Congress of the International Commission on Large Dams. The full story can be found in the government journal *Reclamation Era*, published by the Bureau of Reclamation.

Roosevelt told the audience: "Boulder Dam, in the name of the people of the United States, to whom you are a symbol of greater things in the future, in the honored presence of guests from many nations, I call you to life!"

Dramatically, FDR pressed a telegraph key next to his podium, and the signal from Washington, D.C. energized the master relay on the generator control cubicle in the Hoover Dam power house, thus starting a 3,500-horsepower station service unit.

Millions heard the FDR speech, and listened to a dramatic NBC radio hookup at the Dam, where the electricity opened 12 "pin needle" valves to allow a torrent of Colorado River water to tumble 177 feet from the top of the power house down to the ancient river bed, a waterfall larger than Niagara Falls.

FDR continued, "We are going to see, I believe, with our own eyes electricity and power made so cheap that they will become a standard article of use, not only for agriculture and manufacturing, but also for every home within reach of an electric light line.

"The experience of those sections of the world that have cheap power proves very conclusively that the cheaper the power, the more of it is used."

NBC reporter Laurence Keating followed FDR's speech, and turnkey of power, with this narrative:

"It will take 20 minutes for all 12 to be opened fully —with only the four partially turned on now—there is a definite murmuring roar of falling water—hear it?" [Five seconds or so of light roar].

"…. [T]he power house, in height from foundation, is equivalent to that of a 20-story building. Yet from the top of the dam, which is 560 feet above where we are standing, this power house looks like a bungalow!"

Keating then turned the broadcast over to Cliff Eagle, who was flying over the dam in a United Airline transport plane: "Take it, Cliff Eagle!"

"Boulder Dam is too big to comprehend, all of it at once; and Lake Mead, the largest man-made lake in the world, is of such immense size that we had to come up here to see all of its turquoise waters….

"This is the very heart of what the old maps marked as the 'Great American Desert.' Everywhere we look … we can see what countless centuries of devastating floods have done to this country in the way of erosion … plainly visible, is the mighty Grand Canyon of the Colorado…."

"Right now the basin is one third full … there are 9,500,000 acre-feet of water below me in what was once a land as parched as the Sahara…."

"Boulder Dam looks as though it belonged in this country … seems to blend in with all, as though Nature had put it there."

The broadcast then went back to NBC reporter Keating, on the ground.

"The Boulder Dam project is a fact! The Colorado River flows through man-made tunnels, confined by man-made pipe, harnessed to do man's will and man's work."

Colossus: Hoover Dam and the Making of the American Century

The wheeled drilling jumbo, invented by construction foreman Bernard "Woody" Williams, allowed as many as 30 drillers to attack the tunnel face simultaneously.

U.S. Bureau of Reclamation

The Dam in an early stage of terraforming.

U.S. Bureau of Reclamation

The Dam was an engineering challenge: There were 5,000 men jammed into a 4,000-foot canyon, and each task had to be carried out in the right sequence.

Street-run utilities located in California initially opposed it, producing pamphlets in the 1920s titled "Shall California be Sovietized," when that state proposed a hydroelectric system.

And anti-immigration forces in Arizona lobbied against the Dam, with proposals to divert the Colorado River entirely into that state—and away from Mexico.

The Great Depression

However, by the time the U.S. Reclamation Bureau appointed Francis Trenholm Crowe to superintend the Dam Construction in 1930, the Great Depression had settled over America, and between 1930 and 1932, hoards of hungry, desperate workers descended on Las Vegas looking for work. They established "living quarters" near the actual dam site called "Rag Town," where only scorpions and black widow spiders were able to survive the 120 degree heat in the summertime.

As Hiltzik tells it, Tom Godbey, a former Arizona silver miner, showed up at the Ragtown with his wife Erma, and four children, one only five months old, in the ancient touring car of Erma's parents. No job? "Then you'll have to go down to the river bottom," where no air circulated in the stifling desert heat.

Erma's mother noticed a sign among the raggamuffins labeled "Hell Hole," and shuddered to her daughter, "I am never going to see you again," as they left the destitute family with a mattress, baby crib, and cooking utensils. "Residents" had to sleep in water soaked sheets at night to survive the furnace of the Southwest Desert.

Children would become dehydrated over night, and drink huge amounts of water in the morning. The river water had to be gathered in buckets and left for 24 hours to settle the red silt of the river, before the water became potable.

(I have driven the area in July, in an air conditioned car, and the 110 degree heat hits you like a blast furnace when you get out of your car. These people lived in that desert without recourse to any modern conveniences.)

Tom eventually got a job. The book depicts him at his "tent," a skinny, malnourished worker. (The 4,000 Dam workers were well-fed later on.) Tom's family was

fortunate enough to buy a tent from the widow of a worker for $6. Her husband had died when he prematurely entered a blast tunnel zone, and dynamite blew him and his shovel to bits.

The 'Big Six Companies'

The Reclamation Bureau correctly determined that the Boulder Dam project represented such grand terraforming of the American continent that it required a unified command. Therefore, the government bidding process required companies to bid on the entire project, as opposed to piecemeal elements. Since the job was so huge, six companies, including the then small unknowns Kaiser and Bechtel, banded together to form the "Big Six Companies," which won the bid.

The Wall Street bonding agencies reacted with horror at insuring the winning bid. One bonding agent wrote his East Coast banking clients, "I consider it almost impossible to build. The hazard is much greater than in any construction contract I have ever known."

New England-born Frank Crowe, the building superintendant, had been building dams for the Reclamation Bureau all his professional life, and he was getting good at it. Boulder Dam, however, was twice as large as any project yet attempted in America. Crowe later recalled for *Fortune* magazine, a great promoter of the TVA and Western projects: "We had 5,000 men jammed into a 4,000-foot canyon. The problem, which was a problem in material flow, was to set up the right sequence of jobs so they wouldn't kill each other off."

The right sequence meant that they had to first build four 4,000-foot "diversion" tunnels, two on each side of the river, to divert the river with "coffer dams," so that construction on the actual dam could begin. The two interior tunnels would later feed the turbulent river water into the power turbines, while the outer tunnels served merely to divert the river, and to prevent future floods from overtopping the dam.

The tunnels had to be 56 feet in diameter, and therefore, drilling cylindrical holes in the mountain face with diamond studded drill bits on conventional scaffolding presented a time-delay problem. The apparatus had to be assembled and disassembled before each dynamite blast. Since each blast tore only about 10 feet out of the mountain, a quicker way had to be found.

Central Federal Lands Highway Division

The Hoover Dam Bypass, known as Mike O'Callaghan-Pat Tillman Memorial Bridge, was completed in October 2010, replacing a winding two-lane road. The bridge is 1,700 feet downstream and 280 feet above the Dam, and is an impressive engineering feat in itself. The first arch bridge of its kind in the U.S., it is the longest single-span concrete arch bridge in the Western Hemisphere.

Crowe's engineers used Yankee ingenuity to create "permanent" two-tier scaffolding on the back of large trucks. Eventually, set-up time for all the cables for the electric drills and lights was reduced to 20 minutes, enabling several blasts per tunnel per day.

By the dawn of 1932, there was spectacular progress on the four tunnels. Plans called for diverting the river into the two Arizona tunnels, leaving the Nevada side for reserve in case of Spring floods.

On Nov., 13, 1932, just after Franklin Roosevelt defeated President Hoover in a landslide election, another landslide in the Colorado River Cofferdam diverted the mighty river for the first time since the cofferdam's creation. Shortly thereafter, President Hoover arrived to visit the Dam site. A local reporter said that "I never in my life saw a man look so worn out and completely defeated."

Boulder Dam 'University'

The Reclamation Bureau tested 15,000 samples of concrete in building the dam in 94 different formulations, which were tested in three universities, and two specialized government labs, one of which featured a four-million-ton pressure hydraulic press. They published their findings in a 1938 report which served to advance the "science of concrete manufacture by a quantum leap and would be mined assiduously by dam builders … for years to come."

The Big Six Companies built an entirely new city near the dam site, Boulder City, which exists to this day and has 15,000 residents. (I stayed there at the same hotel as President Roosevelt.) Big Six constructed nearly 1,000 cottages for families, and eight 172-man dormitories for single workers, all featuring air conditioning, a rare commodity at the time. A Big Six subcontract to Anderson Bros. Supply Co. stipulated that they "shall furnish the buildings, water, and light, and required equipment, supplies, and labor … shall be absolutely first class in all respects and of such character and quality as to keep all those employed and using the service satisfied and contented."

In addition, Big Six constructed a cafeteria for 1,200 men, and provided fresh meat, fruit, and vegetables at every meal.

Since there were no dairies in Nevada, they bought an alfalfa ranch, and created a 50-cow dairy to provide milk, cream, and butter, which were shipped daily in refrigerated trucks.

Big Six also commissioned Ford Motor company to build special A-6 International trucks with a 210-inch wheelbase to transport workers to the dam. Ford had to develop a four-blade heavy duty fan and radiator for the truck, which became standard issue for the desert regions of the United States.

Altogether, the government spent $1,135,000 to develop Boulder City from scratch, including the town layout, streets, sidewalks, and installation of sewage and electrical systems.

Several years after Lake Mead filled up, a 5.0 earthquake rumbled through the desert floor from Las Vegas to the newly created Boulder City, felt all the way to Los Angeles, in an area that had previously no seismic activity, in modern times. More quakes followed in the next 10 years.

Later scientists determined that the rapid changes in water levels in Lake Mead during the flood season, and not the actual weight of the Lake, had caused the quakes.

What was the solution? All the seismic activity stopped when the Bureau of Reclamation built another huge dam, 300 miles up river, the Glen Canyon Dam, in the 1960s, and better regulated the flow of the river floods along the entire Colorado River.

Ahead of Schedule

By the time Frank Crowe implemented his ingenious system of cable ways that coordinated the concrete pouring into the dam sections, he was one year ahead of schedule. He had built several concrete plants on location to feed the monster, which devoured 500,000 buckets of concrete, each weighing 16 tons, and comprising 3,500,000 cubic yards of concrete.

The cable ways hoisted each 16-ton load 800 feet in the air over the river, and plunked it down into a designated 50-foot section, where a seven-man crew stomped and shoveled the wet mix into a slowly cooling mass of concrete. Each section contained copper tubing (662 miles in total) which ran refrigerated water to set the concrete in a quickened fashion.

The workers poured the last bucket of concrete on February 21, 1935. By this time, Babcock and Wilcox had constructed an on-site foundry five stories tall, and 670 feet long, to construct the steel "penstocks," which would funnel the raging river into the power house turbines. A photo shows a large inspection delegation being ferried to the dam base in one such penstock, as a crane slowly descended it into place, from 800 feet over the canyon.

Big Six formally handed over the Dam to the Reclamation Bureau, representing the United States Government, on March 1, 1936. In typical New England Yankee style, Frank Crowe told Reclamation engineer Ralph Lowry:

"Take it Ralph, it's yours now. It's a great dam, Ralph."

"Well, Frank," Lowry responded, "you oughta know."

Years after he built the Hoover Dam, Frank Crowe told a reporter from *Time* Magazine about the pending completion of the Shasta Dam in California:

"If you want to see the fellow who really built this dam, go over to the mess hall. He wears a tin hat, his average age is thirty-one, and he can do things."