CYCLING THROUGH SCIENCE - BUILDING BRAWN AND BRAIN WHILE TRACKING NOAH'S FLOOD

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A number of years ago I struck a resonating chord in myself and some members of the Literary Club when I chronicled my early morning row every summer around Great Island in Lake Sunapee, New Hampshire, a reverie on boating, the stroking and recovery of rowing, strain and relaxation, islands and the play they have in our lives, an appreciation of our daily surround. In a different, but also in a somewhat parallel vein, I plan this evening to wander through some of my thoughts about non-vacation reflections and the pleasures and benefits of exercising the mind as well as the frame.

The building brawn side of my story can be dealt with quite briefly. Many years ago, when I chose the rather sedentary specialty of being a psychiatrist, I reviewed the more common occupational hazards of that activity. Those are easily identified and well known - back problems, hemorrhoids, prostatitis for a start - unattractive and debilitating, clearly to be avoided or at least fended off. And why look further, those three gave reason enough to develop a program of preventive activity, which I proceeded to do, without the modern accouterment or benefit of a personal trainer - that wasn't in vogue in those days. And with reasonable though not total success up to the time where we now find ourselves. The core of the program is regular use of an exercycle, a stationary bicycle, an all-weather, flexibly scheduled approach.

The downside of the program is boredom, as in my experience the equation of regular, repeated, routine exercise equals boredom. That boredom has been challenged in many ways over the years - varying the exercise method, listening to music or watching TV - watching TV the apparent winner judging from the standard arrangements of all the fitness centers of which I am aware. My own choice moved towards reading

- a more traditional approach to entertainment and learning. And my choice of reading gradually settled on reviewing the weekly issues of Science magazine and the monthly Scientific American, placing the open magazines on an adjustable rack fitted onto the handle bars of the exercycle.

Necessarily I have to scan the terrain of a given issue of Science fairly rapidly, as I might move my gaze along the shore of my island while rowing. But inevitably, and gratifyingly, my attention will become more focused at intervals, and I will find myself gradually more deeply engaged and immersed in a topic or area of investigation. At such times my reading will continue beyond the exercycle workout and extend beyond the material offered by the weekly Science issue. As often as any other subject I find myself lingering on articles and items about archaeology, the history of early climate changes, the development and dispersion of culture, and the advances in science that allow a deeper and more comprehensive understanding of our early experiences. Thus is a Literary Club paper born.

So, you can hear that a number of themes have come together to generate my line of thinking this evening. Not the least of them is the hot topic of global warming. My scanning of Science suggests that observed climate variability over time - such as we may now be experiencing - is generally characteristic of comparatively intermediate global ice volume - the condition in which we seem to be at the present time. How much man-created factors, such as increased atmospheric levels of carbon dioxide, are tipping the balance toward global warming has not been demonstrated conclusively but expert opinion rests heavily on the side of the fossil fuels having a decided influence. There of course is no doubt that deglaciation is accelerating worldwide as satellite studies show very graphically. How remarkably deglaciation can alter the face of our planet has been an interest of mine, as I referred to in my paper "The Tides of the Ohio".

Early this summer I went through a small sampling of these issues as my wife, Bobby, and I went to the

Scottish Highlands and the Orkney Islands for a two and half week Elderhostel program. The program concentrated on the geology, flora and fauna of the Highlands and how it had influenced the development of Celtic culture. A combination of volcanic and glacial activities molded the area. Some twelve thousand years ago an ice covering a mile thick lay over the region, a covering which began to diminish at that time.

Among the most impressive sites we visited was that of Skara Brae in the Orkney Islands, a five thousand year old Neo-lithic village that was remarkably preserved as it lay covered in sand until being revealed by a severe storm 150 years ago. An impressive exhibit in the small museum on the site recreated the receding of the shoreline over recent thousands of years as the level of the ocean gradually rose. An extensive and sturdy seawall has now been constructed to protect the ancient remains. This combination of melting glacial ice cover and rising sea levels is at the heart of my story but now I will shift to another part of the world and to Noah's flood.

> And the flood was forty days upon the earth, and the waters increased, and bare up the ark; and the ark went up on the face of the waters. Fifteen cubits upward did the waters prevail; and the mountains were covered - Genesis 7:17-19.

Tracking Noah's flood has focused some of my reading while cycling for science. Probably most central in my scanning the shoreline of science is the rapid development of paleoclimatology, the history of ancient climate and its changes, and the closely related paleoceanogaphy, the history of the world's oceans. For instance there have been seven distinct periods or cycles of glaciation in the world in the past 750,000 years. The most recent, cresting probably some 20,000 years ago, and the subsequent subsiding - becoming significant probably 12,000 years ago, occurred at a time when the glacial covering reaching just to the north of the Ohio River and covering Scotland down into or through the Lake Country of England. Some of the recent publications on these studies, made possible by developments in information

technology, include a world atlas of vegetation over the past 150 years or more based on studies of fossil plants and soils. Beyond that has been added the study of stalagmites, and other minerals, and caves containing chemical and mineralogical clues to past rainfall and temperatures. Further data includes the study of sea corals, carrying isotope signatures of sea temperatures, the study of mile deep Greenland ice cores, the study of the rings of old trees, and ancient pollens and spores. All of these databases and resources are now being linked so that large numbers of geographic areas around the globe, some 10,000 of them, can be identified, and the history of temperature, flora and fauna over tens of thousands of years can be organized and studied. This is the rapidly expanding body of information which is being utilized in the studies of global climate change.

For my purposes this evening, and without becoming technical to a sleep producing extent, it has been demonstrated that the average sea level has risen over 300 feet as the last ice age and the ice coverage has declined over the past 12,000 years, and the preponderance of evidence is that a slow increase is continuing in concert with the probable decline of glaciers and polar icecaps. The current estimate by the scientists working in this area is that the increase in sea level is on the order of two millimeters per year, less than a tenth of an inch per year, over the past several decades. When the Antarctic ice sheet did melt in previous deglaciations, one event probably dated 110,000 to 130,000 years ago, geologists believe the sea level then stood about five meters, 15 plus feet, higher than it does now.

However, the current situation is characterized by scientists as "murky" in an article entitled "The Rising Seas" published this past year in the Scientific American. For example, many scientists are now willing to accept that human activities have contributed to global warming but no one can say with any assurance whether the Antarctic icecap, as distinct from more general deglaciation, is growing or shrinking in response. That uncertainty could disappear in just a few years if the National Aeronautics and Space

Administration is successful in its plan to launch a satellite designed to map changes in the elevation of the polar icecaps with extraordinary accuracy - probably to within a centimeter a year. A laser rangefinder is scheduled to be placed in polar orbit in the year 2002.

The rise in sea level over several thousand years may very well play a part in explaining the existence of flood epics in many cultures, the Greeks, the Romans, the Irish, and even native Americans. The Babylonians were the first to preserve the flood legend in script after it had likely been passed down through generations over hundreds, or more likely thousands, of years as oral history told as an epic. This Babylonian legend is the Epic of Gilgamish, from the name of the chief person in the series of tales of which it is composed. The Babylonian tablets, discovered in Nineveh in 1875, contained the tale in cuneiform script and these were gradually translated. Later excavations and discoveries indicate that the epic was first inscribed around 3000 B.C. when cuneiform script first appeared. There seems no doubt that the deluge described in the Gilgamish Legend had been inscribed on tablets long before the writing of the first books of the Old Testament. Scholarly opinion is that the flood epic - Noah's Flood - had been carried by the Israelites as an oral tradition before its eventual redaction in Hebrew script, thought to have happened no earlier than 900 B.C. All of this material is reviewed in the most scholarly and engaging way in a book published in 1998, Noah's Flood, The New Scientific Discoveries About The Event That Changed History, by William Ryan and Walter Pitman, two geophysicists who had been working together for many years.

The occasion for Ryan and Pitman writing this book was the coming together of evidence from studies using the new science. These studies demonstrated that the Black Sea had been a large freshwater lake, part of the consequence of the Anatolian Fault creating a body of water 6,000-7,000 feet deep. Through core studies, borings made from a research vessel of the bottom of this lake, and sonar studies, several shoreline levels were identified.

To add complexity, there were periods, during the deglaciation after 10,000 B.C., of considerable and extended drought so that the level of the Black Sea declined, possibly up to 200 feet, this at the same time that the level of the world's oceans and the Mediterranean Sea were steadily rising. The fresh water Black Sea became a very significant center of cultural development because of the reliably available fresh water, especially during droughts, and the presence of substantial population accumulation is evidenced surrounding this very sizeable area of water.

Around 7600 B.C. the Mediterranean Sea began to crest over the Bosporus, the approximately seventeen mile wide strip of land separating the Black Sea and the Mediterranean. Eventually occasional crestings caused by high winds or storms became a steady stream and the Bosporus was breached. At this time the level of the Mediterranean is thought to have been some 500 feet above that of the Black Sea. The force of the flow of water through the Bosporus is characterized as being two hundred times that of Niagara Falls, causing the level of the Black Sea to rise six inches a day, and to cover 60,000 additional square miles of land in less than a year. (The area of the state of Ohio is close to 42,000 square miles.) All those living around the Sea, now a salt water body of water, were driven to higher land and a true diaspora of the adjacent communities was created. These populations never returned as their essential source of fresh water was gone forever. It is thought entirely possible that the early tribes that created the Celtic culture were among those that were dispersed.

Anthropologists think the story of flooding, devastation, and dislocation was passed through generations as oral history, for 3,000 years. When writing was developed, these epics became recorded as the biblical story of Noah, and the Epic of Gilgamish.

My cycling for science was getting me into some very interesting and fairly deep waters. New clues kept accumulating as I stayed on the track and then much of this material came together in a burst of color in the May 2001 issue of the National Geographic

magazine in an article "The Black Sea Discoveries, Startling Evidence of an Ancient Flood".

The article summarizes the previous work on the Black Sea area and then features the work of Robert Ballard, best known for finding and exploring the Titanic. Ballard arrived with a team of scientists and sophisticated equipment and in 1999 used side scanning sonar to find an ancient coastline 550 feet deep and 20 nautical miles out into the Black Sea. It appeared to be similar to today's Turkish coast, with headlands, beaches, and offshore sandbars. The team used a camera equipped Remotely Operated Imaging Vehicle (ROV) named Argus (question appropriately). The ROV took samples from the ancient beach, including salt water and fresh water mollusks or shellfish species. Radio carbon dating of those shells showed that the freshwater species were older than the saltwater ones. Also the freshwater mollusks were all of the same age, meaning that they died at the same time. Scientists say that this is good evidence that a flood killed them. If they had been killed by slowly rising saltwater their ages would be different. The mullusks' ages are consistent with flooding at about 5600 B.C., about the time Noah's flood is thought to have taken place. The ROV also picked up a piece of obsidian on the ancient beach, a volcanic glass that was often used for tools by preindustrial people. This indicates people may have once worked in that location.

The Ballard expedition returned in September 2000 and likely erased any doubts about Ryan and Pitman's flood hypothesis. While exploring a gently sloping shelf near the convergence of two ancient river channels 311 feet below the surface of the Black Sea, the team found the remains of an ancient structure 13 yards long and 4.4 yards wide. The ROV discovered that the structure, probably a house, had carved wooden beams and wooden branches for walls. The mud or clay that at one time likely held the wood together was now dissolved. Nearby were stone tools, including a stone ax that looked like one in a nearby archaeology museum, and ceramic storage vessels. Although wood should be decomposed under water, the site is close to the Black

Sea's anoxic zone, the deep oxygen-free waters where life is scarce.

These discoveries are important for several reasons. Anthropologists are eager to understand the origins of legend and to learn about the accuracy of oral history as well as the dispersion of culture. Climate change scientists want to understand how climate has changed in the past and what role climate change has had in human history.

My cycling after science on the track of Noah's flood has now shifted to searching the internet, clearly changing the balance away from pursuing brawn while developing brain. And at times frustrating as I am far more familiar with my exercycle and scanning science than I am with the range of search engines available to my mouse. No further developments have been reported in recent months but the dating and identification of the retrieved materials is continuing apace.

Some of you will have noted that I gave short shrift to building brain, as compared to brawn, as I read this evening's exercise. How about that? Can a man, gently described as being of mature years, still build brain? Have I in fact also been developing brain as my subtitle gave promise for as I began? New discoveries have been yielding very interesting results in this area, or shoreline, as well.

Perhaps the most effective and easiest approach to tapping in on these ideas is to refer to a feature in the Boston Globe, Health and Science section this past summer titled, "The Lesson of Old Geniuses" - there's a certain charm to that. The company the editor, Judy Foreman, identified included Einstein, Grandma Moses, Nelson Mandela and Giuseppe Verdi. The subtitle of the feature reads "Scientists once thought brain cells do little but die as they age. But new research raises the hope of intellectual growth to the very end." I thought a few observations here might be of particular interest to this group this evening.

Investigation demonstrates that some mental skills, such as memory and processing speed, decline with age but wisdom and common sense may increase. But overall neuroscientists have been described as having been gloomy about the aging brain, based on their belief that aging causes a steady loss of neurons, or brain cells, and they "knew" the adult brain could not generate new neurons and that little could be done to boost the odds of having a healthy aging brain.

Much of that, scientists have learned over the past decade, was too pessimistic. The aging brain, it turns out, is surprisingly "plastic" - capable of remodeling itself, growing new cells, and compensating in remarkable ways for the very real losses in processing speed that come with aging.

A pivotal study in this area was reported in 1998 by a team led by Fred Gage, a neuroscientist at the Salk Institute in La Jolla, that the adult human brain contains cells that can divide and become healthy new neurons and that this capacity exists throughout life. And just as important, Gage reported, physical exercise and intellectual enrichment can help stimulate this capacity - and the more exercise the more new brain cells.

Well - where does all this lead? Surely there are those in this gathering this evening who recall that Noah lived to be 950 years of age - is that part of my being attracted to Noah's flood?

> And Noah lived after the flood three hundred and fifty years And all the days of Noah were 950 years. Genesis 9, 28-29

Is that an emerging goal and ambition for me? I don't believe so. My inclinations tend much more in the direction suggested by Solzhenitsyn, 83 years of age in 2001, as reported in "Letter from Moscow - Deep in the Woods" by David Remnick as he reviewed Solzhenitsyn's new book "200 Years Together - A History of Russian-Jewish Relations". His interview with the author, reported in an August New Yorker, led him to go back to a prose poem Solzhenitsyn had written since his

return to Moscow in 1994 called "Growing Old". The poem came to Remnick's mind as a long visit with Solzhenitsyn was coming to a close. Solzhenitsyn said, "I'm not working with the old speed." He said, "My work day is different, because once or twice a day I stop to take a rest. I never used to do that. And in the evening I feel tired and go to bed fairly early. In the morning, I feel strong, but this strength doesn't last as long as it used to. It's hard to walk, even to stand. I have to use that cane over there. I have some problems with my spine, so even sitting is a problem now."

And then the poem, "How much easier it is then, how much more receptive we are to death, when advancing years guide us softly to our end. Aging thus is in no sense a punishment from on high, but brings its own blessings and a warmth of colors all its own. . .there is even warmth to be drawn from the waning of your own strength compared with the past - just to think how sturdy I once used to be! You can no longer get through a whole day's work at a stretch, but how good it is to slip into the brief oblivion of sleep, and what a gift to wake once more to the clarity of your second or third morning of the day. And your spirit can find delight in limiting your intake of food, and abandoning the pursuit of novel flavors. You are still of this life, yet you are rising above the material plane. . .growing old serenely is not a downhill path but an ascent."

I have reflected at length about the poem.

So I await further news and developments from the Black Sea, checking the internet while also continuing to cycle through science. Too much is happening and too fast for me to feel that I can keep up with everything, but I'm enjoying the ride and the view. And as I step off the exercycle, more prepared to move gracefully and comfortably through my daily rounds, my mind looks forward to studying the cycles of man's experience here

on earth, both as an individual and in communities, in the present and in the past.

I'll keep you posted.