

9-1-2004

## Interview with Dr. David Goodstein

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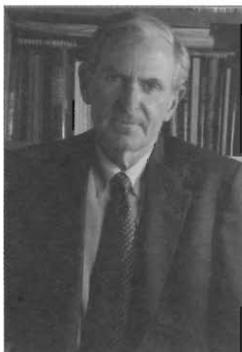
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### Recommended Citation

Harrington, Mary Kay (2004) "Interview with Dr. David Goodstein," *Moebius*: Vol. 2: Iss. 2, Article 16.  
Available at: <http://digitalcommons.calpoly.edu/moebius/vol2/iss2/16>

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Dr. David Goodstein

## INTERVIEW WITH DR. DAVID GOODSTEIN

Author

David Goodstein is the Vice-Provost of Cal Tech and author of *Out of Gas: The End of the Age of Oil*

*MKH: Why did you write your book and are people reading it?*

*DG:* I'm pleased about the book. It's in its 5<sup>th</sup> printing now. I wrote the book because I believe that we have big decisions to make as a society. First of all, though, we must understand the relevant laws of nature. We can hope to change the laws of peoples, but we can't change the laws of nature. I try to sketch out, for those who are not specialists, both the opportunities and limitations that nature has provided for us. Only if we understand both can we hope to proceed with wisdom.

*MKH: Your book discusses the problems with our energy sources.*

*DG:* First of all, fossil fuels are finite resources. We have a number of fossil fuels: conventional, light crude oil, heavy oil, oil and tar sands shale oil, natural gas, methane hydrate, coal. All of these are finite. In fact, we will probably see the beginning of the end of fossil fuels in the 21<sup>st</sup> century.

The other huge problem with the use of fossil fuels is that burning does unpredictable damage to the climate of the planet.

*MKH: Some people (including the present Republican administration) say that the environmentalists keep us from oil exploration, that if more drilling would be allowed (e.g. Alaska, off-shore of California, etc.) we would find enough oil to survive.*

*DG:* That's nonsense. Take, for example, the Arctic National Wildlife Refuge. We really don't know how much oil is in it, but let's suppose that the expected 10 billion barrels are found. The reality is that it would supply the world's demand for only a few months. Two-thirds of the world's oil is in the Middle East. That's ten times the amount that is in North America. More drilling here just won't make much difference.

I can't imagine that anyone really believes that the war in Iraq has nothing to do with oil.

*MKH: What about the alternatives to fossil fuel? What are their benefits and drawbacks and which do you think hold out the most hope for us?*

*DG:* First of all, let me talk about solar. One indirect source is hydroelectric power. The enormous pressure of water in a reservoir provides the force to drive a water turbine, which generates electricity. Then the sun makes the water evaporate and the rain resupplies the reservoir. We get about 1/4 of our electric power from that source, but we've already built dams everywhere we can.

Secondly, we have wind power, which is another indirect form of solar energy. About one tenth of 1% of us electric power is generated by the wind. That will grow, but wind is an intermittent source that will never be sufficient by itself.

Biomass is another small source of energy. It means that you grow something that you burn. Some crops are more efficient than others at converting solar energy to chemical energy, but, essentially, it's inefficient.

Solar cells, also called photovoltaic devices or *PVs*, also have drawbacks. To replace the power generated from fossil fuel, an area 1/2 the size of California would have to be covered with *PVs*. Right now, all the *PVs* in use ever made probably wouldn't cover the Cal Poly campus. On the other hand, the amount of solar energy that reaches the Earth is about 20,000 times the fossil fuels we burn. The question is how do we use this solar energy.

*MKH: What about hydrogen? The politicians are suggesting that it might be the answer.*

*DG:* It's silly to talk about hydrogen as our savior. In order to make hydrogen, fossil fuels are needed. It takes, for example, 3-6 gallons of fossil fuel to make enough hydrogen to replace one gallon of gasoline. Even if we could make it more efficiently, it's dangerous and difficult to handle, and its leakage into the atmosphere could damage the ozone layer.

*MKH: What about nuclear energy?*

*DG:* It's not the answer, but it may be part of the answer. I call it a bridging technology. The problem with conventional nuclear energy (fission) is that it uses uranium 235, and if we use that up fast enough to replace the fossil fuel we are burning, the known reserves would last only 10-20 years. Breeder reactors are an alternative that could increase the energy available from uranium, about 100 times the energy. But it also converts uranium into plutonium which is very dangerous. Plutonium can make bombs. For that reason, there are no commercial breeder reactors in the US, and making this a safe enterprise would be difficult.

Fusion may be the best hope for the future. It's fuel would virtually last forever, and it wouldn't contribute to carbon dioxide in the atmosphere. The problem is that nuclear

fusion power has been 25 years away for the past 50 years, and it is still 25 years away. If nuclear fusion ever does become practical, the primary fuels (at least at first) will be deuterium and lithium. Deuterium is found in sea water: the deuterium in 1 gallon of sea water can produce the energy equivalent of 300 gallons of gasoline.

Generating usable hot fusion power will require a huge facility. The International Thermonuclear Experimental Reactor (ITER) which has been formed by a collaboration among Canada, the European Union, Japan, Russia, and the US may be one hope. The first one will be built in either Japan or France, and this experimental reactor could be very important. The hope is that, within a decade, the reactor will reach break-even, that is, the same amount of energy that is put in will come out. However, that's still very far from having practical power plants.

*MKH: So, you see one of the great hopes in some sort of global collaboration?*

*DG:* Absolutely. But it doesn't always work. The Kyoto Protocol is an example. It is a rather weak attempt to reduce the rate at which the world pours carbon dioxide into the atmosphere. The Russians just ratified the agreement. The US has refused.

We do not have the kind of political leadership that would ask us to sacrifice our current prosperity for the sake of our planet's future.

*MKH: What should be asked of Americans? Sacrifices of some kind?*

*DG:* Well, the reservists in the military are the ones being asked to sacrifice in the Middle East right now. However, we here at home don't really need to sacrifice if we learn to build and use more efficient cars, factories, houses, etc. With 5% of the world's population, we now use 25% of the world's energy. We could do much better.

*MKH: What is the most crucial issue about global warming?*

*DG:* Probably to understand it as a political issue. We have to take drastic steps to change what we're doing. It's not just a matter of the planet getting a little warmer. We could wind up throwing the planet into a completely different state, possibly one hostile to life. The planet Venus could be Earth-like in temperature, but instead it has a runaway greenhouse effect giving it a surface temperature hotter than molten lead. We don't know whether that could happen to the Earth if we keep pouring carbon dioxide into the atmosphere. And I'd rather not find out.

*MKH: What would a coherent energy policy look like?*

*DG:* We need leadership with wisdom and vision. Frankly, neither of the political parties is dealing with this issue honestly. As a practical matter, no politician will be elected for telling Americans they must give up their SUVs. But a brave leader could say that we must end our dependence on corrupt and unstable regimes in the Middle East, and stop endangering the climate of our planet. The only way to do that is to kick the

fossil fuel habit. I think if the world's scientists and engineers were given the necessary resources and challenged to develop solar and nuclear technologies to replace fossil fuels as a source of energy, it would be possible to accomplish that.

*MKH: What kind of car do you drive?*

*DG:* A hybrid Prius. It's rated at 60mph in town. But gas prices won't scare people into getting more efficient cars until gasoline becomes much higher than it is now. Today gasoline is cheaper than bottled drinking water. I have to come clean: my other car is a Lexus. 

*Interview conducted by Mary Kay Harrington, who directs the Writing Skills Program and teaches in the English Department.*