Denmark Opens Bridge to Sweden

Poul E. Rasmussen reports on the completion of the second of three planned great infrastructure projects, the Fixed Link across the Øresund.

On July 1, Denmark celebrated the completion of yet another great infrastructure project, the Fixed Link across the Øresund, the narrow strait separating Denmark and Sweden. Two years ago, it was the Great Belt Fixed Link, whereby the eastern and western parts of Denmark were connected by 17.5 kilometers of combined highway bridges and a rail tunnel. This time, another set of highway bridges, an artificial island, and a tunnel come together to form a 16 km-long rail and road link between the Danish capital city of Copenhagen and Malmö, the largest city in southern Sweden. With the opening of the Øresund Fixed Link, Denmark has completed two of the three major infrastructure projects which were planned in the beginning of the 1990s. The third one, an 18 km-long rail and road bridge across the Fehmarn Belt in the western part of the Baltic Sea, connecting southern Denmark with northern Germany, is still in the planning stage. The project presently under consideration is a chain of huge cable-stayed bridges carrying both rail and highway traffic. The construction could commence within a year or two, pending the final green light from the German government in Berlin.

A Miniature Eurasian Land-Bridge

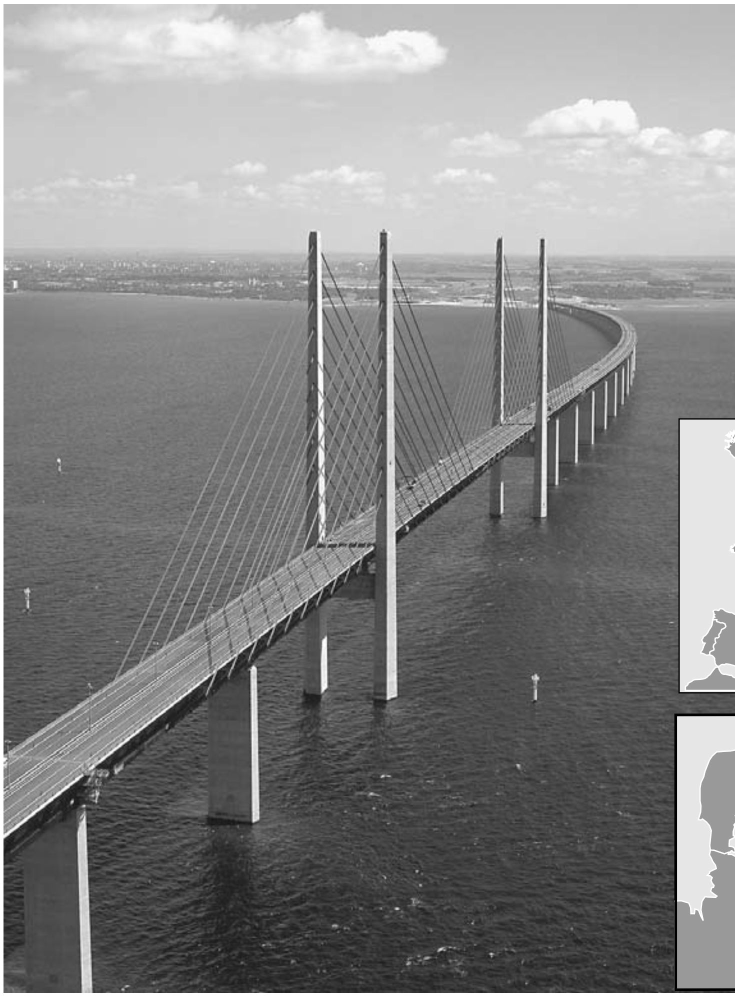
The best way to describe the new infrastructure in place in Denmark and Sweden, would be to take an imaginary journey from Hamburg to Malmö. Although all the bridges to be crossed actually span water, the journey could be seen as a preview of the kind of infrastructure that would be involved in the realization of Lyndon LaRouche's conception of the Eurasian Land-Bridge.

In the 400 km between Hamburg and Malmö, you encounter one of the highest concentrations of large-scale transportation infrastructure in the world. From Hamburg, you go north through Schleswig-Holstein to Fredericia, Denmark. Here, you turn east, crossing the first major bridge, the Little Belt Bridge. It is a suspension bridge, constructed in 1970, with a central span of 600 meters. The pylons reach 120 meters into the sky, and the road is suspended 42 meters above the water. Rail traffic is still carried across the Little Belt by the old steel rail and road bridge built in 1935. The highway continues across the island of Funen, and after driving for 45 minutes, you encounter the Great Belt. Here, the first bridge, the Western Bridge, is a low, 8 km-long road and rail bridge. In an elegant southerly bending curve, it swings across the water to the tiny island of Sprogø, in the middle of the Great Belt. At Sprogø, the railroad and road are separated. The railroad dives into an 8 km-long tunnel, which, at its lowest point, goes as deep as 40 meters below the sea bed; the road enters the imposing Eastern Bridge. With pylons towering 254 meters above sea level, and with a center span of 1,624 meters, it is the second-largest suspension bridge in the world. Driving on the deck 70 meters above the water, even the largest freighters beneath you seem like tiny model ships. The total length of the Eastern Bridge is 6.8 km.

On the island of Zealand, you have a good hour's drive before you reach Copenhagen. Entering from the southwest, the highway takes you around the city directly to Copenhagen International Airport. Here you find exit signs for "Ørestad," an entirely new city center being built in connection with the Øresund Fixed Link. University departments, offices, theaters, apartments, and a brand new subway will make Ørestad a vibrant part of Copenhagen within the next few years.

At the Copenhagen International Airport, the Øresund Fixed Link has already left an impressive mark of improvement. A brand new terminal, built in the shape of an airplane wing, stretches out to the edge of the highway, and beneath it, you find a whole new railway station receiving trains directly from Germany, Norway, Sweden, and other cities in Denmark. Within the coming weeks and months, it will become one of the busiest railway stations in northern Europe. At the eastern edge of the airport, you enter the first section of the Øresund Fixed Link, a 4 km-long tunnel, carrying a four-lane highway and a two-track railway underneath the western part of the sound, out to an artificial island called Peberholm (Pepperholm). According to the original plans, the tunnel should have reached the neighboring natural island of Saltholm, but out of environmental concerns for the bird habitat, it was decided that a brand new island would be built. As it turns out, the birds didn't seem to mind the heavy traffic during the construction period at all, and they have already heavily populated the new island, too.

From Peberholm, which stretches 4 km into the sound, one enters the western approach bridge. It carries two levels, a four-lane highway on top and a two-track railway below. Over a distance of 3 km, the approach bridge gradually rises to meet the high bridge, which has four independent pylons, each 204 meters high. The span between each pair of pylons is 490 meters, and through 80 pairs of cables, they take the road and railway decks 57 meters above the water. From the high bridge, the eastern approach bridge gradually descends to meet the Swedish coast, making the entire bridge 7,845 meters long.



The Øresund Bridge, a 16 kilometer rail and road link between the Danish capital city of Copenhagen and Malmö, the largest city in southern Sweden, which opened on July 1.

In Sweden, major infrastructure projects are under way. Ten kilometers of railway and highway have already been constructed, to connect the bridge to the existing Swedish road and rail infrastructure. By the year 2007, a railway tunnel under the old harbor and the city of Malmö, will connect the railway station directly to the bridge. Since Malmö is the southernmost city in Sweden, the old rail lines all came in from the north. Malmö central station was the terminus for the entire country. Therefore, the railway from the new bridge, which is located just south of the city, has to temporarily go in a full circle around the city in order to reach the main station. This will change with the new tunnel.

Playing with Physical Geometry

It is tempting to make a comparison between the Great Belt Fixed Link and the Øresund Fixed link. Both are huge and very impressive, but they are also very different. Located within 120 km of each other, the two projects represent unique engineering solutions to two different sets of physical problems. Now, this is in a tiny country like Denmark. Imagine the variety of physical problems that will have to be solved to connect the eastern and western regions of Eurasia through a land-bridge, or several land-bridges.

In the case of the Great Belt and the Øresund projects, maximum use was made of the experience gained from the first construction project, in the next project. Entire work teams were moved directly from either the tunnel or the bridge projects on the Great Belt, to the equivalent projects at Øresund. This resulted in a tremendous rise in efficiency. But, making maximum use of the practical experience from the Great Belt, did not mean that you could just copy the entire project and repeat it at the Øresund. The problems that arose while building the Great Belt tunnel were very different from the ones that appeared in the Øresund tunnel; the problems encountered during the construction of the two sets of low bridges were very different; and so on.

The most glaring difference though, is reflected in the construction plans for the two main bridges. They are both very beautiful, each in its entirely distinctive way. The Great Belt Bridge is a classic suspension bridge, probably the most beautiful of its kind on this planet. It is tall and slim and graceful. The upwardly bending car deck, shaped in the form of an airplane wing, and the soft catenary curves of the two suspension cables, give you a sense of motion. And that is actually what it does. The Great Belt Bridge moves—all the time. The construction was planned to allow for motion.

The Øresund Bridge, on the other hand, gives you the opposite impression. The straight lines of the cables are clear signals of rigidity. And the bridge is very rigid. It has to be. Every day, loaded trucks will thunder across the car deck, while heavy freight trains travel past one another on the rail tracks below. Here you don't want to have motion—you would never be able to control it. You want solidity and rigidity.

All the differences were dictated by the local geographical challenges. In the case of the Great Belt, the conditions of the sea bed demanded that the bridge be constructed at a location where it would not be standing perpendicular to the main waterway of the Belt. This meant that the ships would travel under the bridge at an angle, which is why, for safety reasons, the span of the bridge would have to be very wide, minimally 1,500 meters. The Great Belt is a major international shipping lane. A suspension bridge can have that kind of span, but it cannot carry both auto and rail traffic. A cable-stayed bridge can carry both auto and rail traffic, but it cannot have that wide a span. The solution at the Great Belt was to send the railway via tunnel and the cars via suspension bridge.

Why not use the same solution for the Fixed Link across the Øresund? Here, the shipping lanes run exactly perpendicular to the best location for a bridge. This reduced the safe width of the main span to approximately 400 meters. At the same time, it is well known that a geological fault line runs through the eastern part of the sound. An underwater tunnel in an area with many, but minute earthquakes? Not a very attractive idea. Therefore, the solution was a cable-stayed bridge for both road and rail, which could be constructed with a 400-500 meter span.

While the Øresund Bridge, for good reasons, is more sturdy in comparison with the Great Belt Bridge, the engineers took pains in their design to give the bridge some touches of grace. Each of the 41 piers that support the approach bridges, only reaches the bridge deck at two tiny points at the edges. It's like an old-fashioned waiter holding up his loaded tray with the tips of his fingers. And, by gradually changing the angles at the joints between the segments, the bridge is given a beautiful, continuous c-shaped curve along its entire length.

Since the four pylons of the high bridge carry their own part of the weight of the bridge independently of each other, there was no practical reason to put in the traditional transverse bars between each pair. But, the missing cross bars would create an annoying optical illusion. Reaching 204 meters into the skies, the laws of perspective would make the pylons look as if they were leaning towards each other when seen from the car deck. This could create panic in many family cars, if the children started screaming that the bridge was about to fall, as the car approached nearer and nearer to the pylons. Here, the engineers resorted to an old optical trick from ancient Greece. In order to make the pillars of the temples look parallel when seen from the ground, the ancient architects made them wider at the top. The same is done on the Øresund Bridge. Here, the pylons are gently leaning outwards, creating the impression—actually, the optical illusion—that they are standing perfectly parallel.

Science vs. Hype over the Human Genome

by Colin Lowry

The following commentary is reprinted from the Summer 2000 issue of 21st Century Science & Technology *magazine.*

The sequencing of approximately 90% of the human genome has been hailed by President Clinton as a great breakthrough of our time, and has been compared to the discovery of a "Book of Life" by most of the popular press. Well, the President could have called a press conference a few years ago, saying we had sequenced 60% of the genome, so what has changed, why now is it a "breakthrough"?

The Human Genome Project is not a scientific breakthrough at all. Lost in all the hype, is the reality that we don't know what 97% of the DNA already sequenced means. A breakthrough in science signifies that a new principle has been discovered that changes our previous assumptions. The sequencing of the DNA of the genome has been going on for decades, yet no new principle about living systems has been learned from it alone. The identification of gene sequences that are involved in inherited diseases has been useful for early screening and treatment of people at risk, though the development of treatments has come from entirely different areas of research. The Human Genome Project is basically a brute-force application of automated DNA sequencing techniques, which have become quicker and more sophisticated over the years.

Behind the hype is a more devastating error of method, associated with the reductionist assumptions of Information Theory that dominate nearly all scientific thinking today. Just as Information Theory applied to the human mind can never describe the generation of a new thought, the sequencing of the so-called *DNA code* can never describe life. The radical reductionist view of the Human Genome Project rests on genetic determinism: Whatever happens in the cell is said to be "all in the genes."

This view turns living processes upside down, and views the cell as *existing for the sake of the DNA*. However, this approach runs into an insoluble problem in accounting for the regulation of gene activity, by creating an endless string of kinetic events of enzymes binding to DNA sequences, and DNA being transcribed into enzymes. By this logic, the cell is reduced to a complex series of chemical reactions, that in principle are no different from a machine. The Human Genome Project is dominated by this type of linear assumption, which then asserts itself onto the intrinsically nonlinear living