

*Louis Friedman, 10 August 2014*

It is hard to restrain myself in praise of ESA's Rosetta mission. After a decade of deep space flight (preceded by a previous decade of design and development) the European Space Agency (ESA) spacecraft rendezvoused with Comet Churyumov-Gerasimenko (hereafter called C-G). This is the first ever rendezvous with a comet – that is not just flying by, but matching position and velocity to fly in the same orbit in formation with the comet. C-G was picked as the target because it is an active comet, with water vapor and icy chunks boiling off of it as it gets closer to the Sun in its elliptical orbit. The particles coming off the nucleus are what forms the distinctive coma and tail of a comet. The rendezvous permits extended observations its activity – and in a few months ESA will attempt to deploy a lander (named Philae) onto the comet's nucleus. There it can make measurements of its composition and structure. In a year, the comet will reach its perihelion (closest point to the Sun) – it will then be a dynamic hostile place whose activity can be observed and measured: not without risk, but more on that below.

The technical achievement is notable – ten years in deep space is a long trip – Europe's longest; NASA's done that, but no one else has. The trip included three Earth gravity assist swingbys and one from Mars, plus two close-up asteroid encounters. The rendezvous is a testimony to terrific guidance and navigation.

Rosetta is also a political achievement and creates a special relationship between Europe and comet exploration. This is no small thing – comets are most certainly the primal source of water on Earth and their heavy concentrations of organic material make them relevant to the investigation of extraterrestrial life and even to the origin of life on Earth. As C-G heats up and boils off chunks of ice and organic particles, Rosetta and Philae will observe and measure them and maybe see some of the precursors and building blocks of life that whirl through our solar system.

Europe's special relationship with comet exploration started with an achievement more than a quarter-century ago: the 600 km(!) 1986 flyby of Comet Halley – flying through its coma and taking close up pictures of its nucleus. That close flyby was a risk. ESA courageously took that risk with results of both great gain and great pain.

The exploration of Halley's Comet by Russia, Europe and Japan (sadly, not the U.S.) is a dramatic story of national boldness and international cooperation. I was fortunate to be a participant and witness to the Halley encounters – first in the (then) Soviet Union with their first publicly open mission and then in Darmstadt, Germany where representatives from more than 20 countries were present as Giotto flew through the Comet. The U.S. rejected doing a Halley mission and the Soviet Union responded diverting their planned Venus mission to fly on to the comet and Europe responded with its first interplanetary mission. The daring ESA

close flyby was achieved with cooperation from the Soviet Union which had sent two spacecraft through Halley's Comet (approximately 8000 km from the nucleus) just one week before Giotto. The U.S. also cooperated as part of an International Halley Watch. The Soviet measurements of Halley's position and NASA's accurate tracking of all the spacecraft helped Europe to target so close to the nucleus. So close, in fact, that particles flying off the comet hit the spacecraft perilously interrupting the encounter communications. Those watching live didn't know what was happening – a public relations problem compounded by the recalcitrance of the chief imaging scientist to release the close-up pictures of the nucleus. That led to the ESA's great pain: one of the live TV audience was Margaret Thatcher, Britain's Prime Minister, who was angry at the lack of immediate good images and later made trouble for ESA when funding decisions had to be made. Some have suggested her pique was a major factor in Britain's laid back attitude toward space in the past 25 years. The great gain was that the spacecraft survived the bombardment by comet particles and the pictures, when finally released, were terrific – showing a comet nucleus in detail, for the first time. Jets stream from its surface were visible. It was risky to go so close – as will be the risk of the Philae landing on C-G in November.

The European Space Agency isn't like NASA. The politics that create European space ventures make American politics look simple – almost rational. There are 20 national members of ESA, some with their own space agencies, plus Canada is an Associate Member. ESA gets its budget after a very complicated negotiation among the member countries (plus some from the European Union) with countries being able to pick and choose, to a limited extent which programs they want to support and which they don't. The amount of support a country gives directly affects how much their industry will get to participate. In another major difference from the United States is that the science funding for the projects comes from the countries' individual science agencies, not from ESA at all. One result of this complicated decision making is that decisions, when finally made, seem to stick. The decision to attempt the comet rendezvous was made in the years following another Giotto Rosetta survived political, budgetary and political upheavals in the 1990s (including a launch delay and change of target comet) because of the stickiness of decisions made in this international environment. A similar consistency is going on now with the European ExoMars mission – going through its own upheavals and delays, but still staying the course with its plans (with launches in 2016 and 2018, with Russia).

ESA deserves great credit for the long flight and the technical achievement of comet rendezvous, and perhaps even more credit for taking the risk with the comet lander. The twin comet achievements: Halley (then the closest flyby ever of a comet) and now Rosetta, with its rendezvous and soon-to-be landing are unique

triumphs for Europe. Celestial achievements get national imprints – the Russians at Venus with their several landers, Japan with Near-Earth asteroid sample return and the U.S. at the outer planets (and their moons): Jupiter, Saturn, Uranus, Neptune and soon-to-be Pluto. And, Europe at the comets. Each of these is special and unique to its country.

Carl Sagan once said, “Centuries hence when current social and political problems seem as remote as the problems of the Thirty Years War are to us, our age may be remembered chiefly for one fact: It was the time when the inhabitants of Earth first made contact with the vast cosmos in which our small planet is embedded.” I’m betting that the comet rendezvous by ESA will be part of that remembered contact.