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■ Il est particulièrement inhabituel (pour ne pas dire inédit...) de voir soumettre des textes d'outre-Atlantique pour une publication dans notre revue. A fortiori lorsqu'il s'agit d'honorer un de nos compatriotes. C'est pour cette raison que nous reproduisons cet interview de CLAUDE NICOLLIER fait aux USA dans sa langue d'origine (Réd.)

■ *Es ist sehr ungewöhnlich, um nicht zu sagen einmalig, jemals einen «Transatlantischen Beitrag» zur Veröffentlichung in unserer Zeitschrift zu erhalten. Dies gilt umso mehr, wenn einer unserer Landsleute uns damit beehrt. Aus diesem Grund geben wir dieses in den USA gemachte Interview mit CLAUDE NICOLLIER in der Originalsprache wieder.* *(Die Redaktion)*

CLAUDE NICOLLIER interviewed by JOHN ALLAN COHAN after the STS-103 mission.

«The mission was very successful...»

JOHN ALLAN COHAN

Astronaut CLAUDE NICOLLIER, born in Vevey, Switzerland, is the first European to become a NASA astronaut. A veteran of four Space Shuttle flights, DR. NICOLLIER granted us this exclusive interview in January, just two weeks after returning from the dramatic servicing mission to repair the disabled Hubble Space Telescope (HST), in which he installed new gyroscopes and a new computer. The HST was disabled in November, 1999, because four of its gyroscopes went on the blink.

DR. NICOLLIER was a member of the first group of European astronauts selected by the European Space Agency (ESA) in 1978. Two years later, NASA hired him to train as a Space Shuttle mission specialist.

An astrophysicist in his own right, DR. NICOLLIER received a B.S. degree in physics from the University of Lausanne, and an M.S. degree in astrophysics from the University of Geneva. DR. NICOLLIER served as a captain in the Swiss Air Force. He flew in squadrons of hawker hunters.

DR. NICOLLIER, trim and modest in demeanor, with a shock of silver hair and a quick smile, is easygoing yet intense. Speaking in the French accent of his native Lausanne, Switzerland, he started by filling in his background:

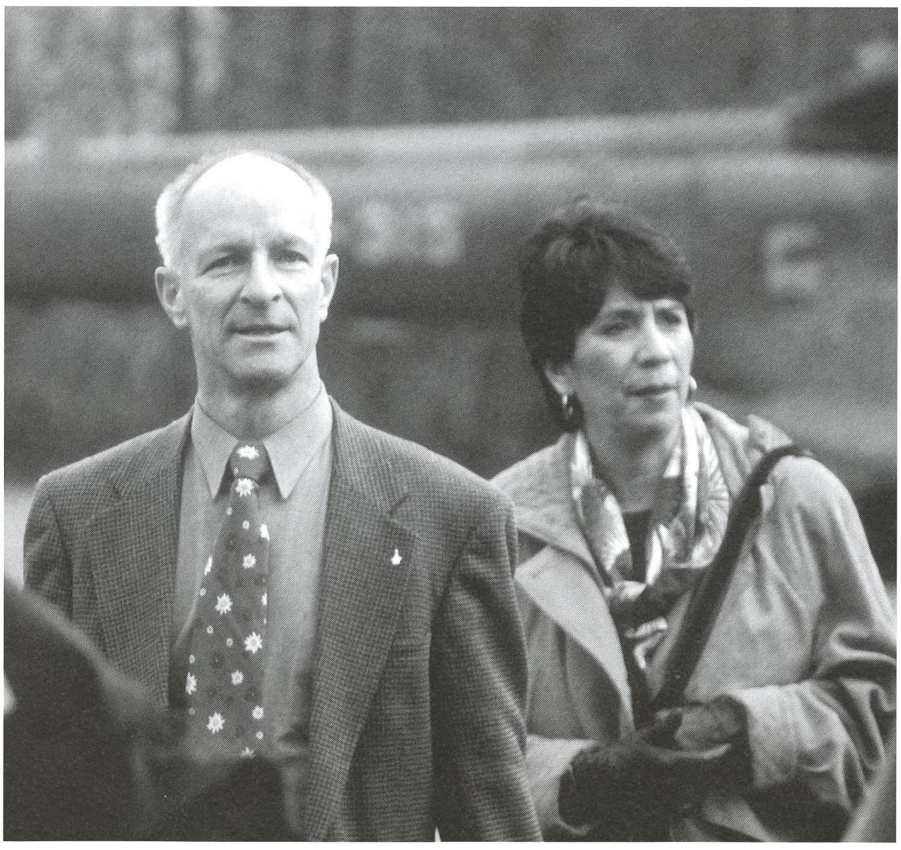
«I divided my time between flying with my squadron for the Air Force and doing research. My research was in stellar photometry, and I spent time on mountaintop observatories like Gornergrat and Jungfraujoch. I also went to Chile as part of the first group of Swiss astronomers to continue our work in the southern hemisphere.

«I temporarily interrupted my research at Lausanne University to train as an airline pilot in Zurich, and flew for Swissair from 1973-76. In '76 I wanted to go back to science and accepted a position with the European Space Agency as an infrared astronomy research scientist, did that for one year, and then I was selected by ESA as a member of the first group of European astronauts. That was the beginning of my astronaut career.»

How did you get hired by NASA as an astronaut?

«I trained in Europe for 3 years as an astronaut. The plan was to fly the Shuttle on the Space Lab mission, which was the contribution of ESA to that mission. Then NASA accepted me to train as a mission specialist at Johnson Space Center, with responsibilities for science, robotic work, and space walks. I was NASA's first non-American specialist trainee.

«It was quite a step for Europe to get its first astronaut to train as a mission specialist for NASA. Soon I was assigned to a mission called EOM (Earth Observation Mission), but it was canceled because of the Challenger accident. There were a few years of wait, and eventually I flew in 1992 on the 46th Shuttle mission. This was to deploy European research (EURECA) to test tethered satellites, and to conduct experiments to generate electric power without using solar arrays. That mission was a partial success. The deployment worked fine but the satellite test was shortened by a jam in the cable.



CLAUDE NICOLLIER and his wife SUSANNA arriving at the Geneva Observatory after the STS - 103 Hubble Space Telescope repair mission of December 1999.

«I flew in '93 on the first Hubble Space Telescope servicing mission [STS-61], where we achieved correction of faults in the primary mirror by installing correcting devices that gave it good sight again. I was a mission specialist again in 1996 [STS-75] on a tethered satellite mission.»

What do you think the study of astronomy contributes to to the world? Many people think it's of intellectual interest, but that it falls short of concrete benefits to society.

«Astronomy gives us a perception of where we are going and where we are from. It helps address a fundamental question for humans about our place in the universe. Astronomy is a significant extension of our understanding of the universe in general. Planetary astronomy is important to understand the future of Earth; if we understand Mars we can understand what might happen to Earth in the future.

«There is the intellectual question of where we come from, where we are going, but also the survival question of how we can best manage Earth, to keep it a decent habitat for people in the next millennium. Astronomy can help us find out how life arose on Earth, whether life came from the interplanetary medium, for instance.

«Astronomy isn't just satisfaction of intellectual curiosity but links to the survival of the human species. Also, it's a tremendous motivation for young people to understand math and science. It fascinates the public; it's an extremely popular field of science, and it's becoming more so with time.

«Also, we get science from the Space Shuttle itself. We make our own water and electricity on the Shuttle. Robotic applications are being developed for human use based on Shuttle technology. The Shuttle has a few dedicated science flight with experiments to do with medicine, biology, earth science and atmospheric science. Some missions have studied biological samples to see how they behave in zero gravity; or biological samples are exposed to the outer environment to see how life responds to ultraviolet radiation. And there have been physiological studies of astronauts to see how the body reacts to zero gravity; and experiments have studied the behavior of animals in the absence of gravity.»

What were your specific tasks on last month's Hubble service mission?

«The primary purpose of the mission was to replace gyroscopes inside the telescope that allow it to maintain an attitude in space in order to do science. Gyroscopes, or gyros, are needed for pointing the telescope. They measure altitude when Hubble is changing its pointing from one target – a star or planet, for example – to another, and they help control the telescope's pointing while scientists are observing targets.

«Originally there were 6 gyros, 3 of which were backups. Three are needed in order for the HST to work, and we had lost four – the fourth went out in November, just a month before our mission. The telescope was no longer able to operate. In a way it was a rescue mission because the telescope was not functional. We installed a whole complement of gyros, which were upgraded as well.

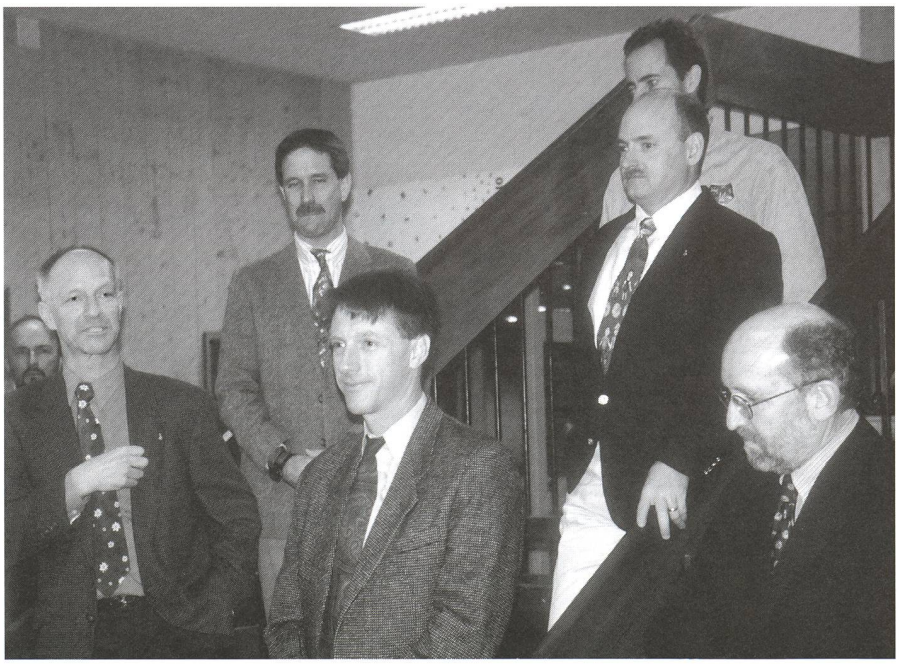
«Also, we were to replace the Hubble's onboard computer, which had been upgraded in the previous servicing mission, but which we now replaced with a completely new computer 20 times faster and with six times as much memory. The new computer was previously tested in the Space Shuttle for l0 days in l998, to insure it could withstand bombardment by cosmic and solar radiation and work flawlessly in the extreme temperatures of space for the rest of Hubble's life.

«We replaced one of the fine guidance sensors – these are in the attitude control loop of Hubble – in order to insure fine pointing (.007 of an arc second) and very precise maintenance of attitude. We also replaced the transmitter and the solid state recorder, which is essential for efficiently handling the high volumes of data from Hubble's instruments. All the rest, like installation of a new thermal blanket layer and replacement of latches on Hubble's bay door – we couldn't accomplish fully because we could only perform 3 out of the 4 planned space walks. As you know, our launch was delayed quite a bit, and we had to be back by December 27th. NASA wanted the Shuttle back before Y2K with enough time for post landing processing of the orbiter, and to get the whole orbiter shut down during the transition to 2000 with a few days of margin – just in case there might be any Y2K problems.

«The mission was very successful within a somewhat reduced objective; 95% of the objectives were accomplished. The new thermal blanket layer was sort of a get-ahead task, to be done in the next servicing mission, but that doesn't impair the ability of the telescope to work perfectly now.»

As an astronaut in a dramatic servicing mission, how do you approach teamwork with your fellow astronauts and ground support?

«Teamwork works very well in a program like this one. In my four missions so far there hasn't been anything more than slight disagreement that was solved rapidly. It's an ingredient of success to have team work, not only with the team in the Shuttle, but teamwork shared with ground support. There has to be good communication. I



From the left: CLAUDE NICOLLIER, JOHN GRUNSFELD, MICHAEL FOALE, SCOTT KELLY (Pilot) and JEAN-FRANCOIS CLERVOY are greeted by MICHEL MAYOR (lower right).

personally have never had any problems. In this last mission we were particularly under pressure to work together to accomplish the mission objective. Each astronaut has the same primary purpose – to have the mission be a success, and this binds the crew. I knew from my colleagues that minor friction can occur but never anything major. I have lived something similar with a squadron, a small group of pilots, with tasks that are difficult and dangerous. Inner conflicts with a tight group like this are rare.»

This was your first space walk. Actually, it isn't a «walk,» you are busily working, not walking. What was it like?

«Yes, this was my first space walk, and also the first space walk by a European astronaut. This space walk was for me an 8-hour excursion outside, together with Mike Foale; we had trained together for about seven months including about ten times as much water time – time in a pool where we do most of our training – as we were going to spend on our space walk. For me the space walk was very packed with a lot of tasks to perform. I started to work just like I had in training; I knew there was very little time to take a break to look at the Earth or look at the stars. Each minute of the space walk was so packed with important work to do. It was very rigorous, but also very exciting. The eight hours seemed like only two hours.

«This sensation of being suspended between space and the Earth was really amazing; you are just floating free in formation with the Shuttle, being attached by a thin wire.

«The training in the large water tank was such that I felt very well prepared. It was like another water exercise, but no bubbles around me.»

What would happen if an astronaut broke loose and started floating away from the Shuttle? What's the emergency protocol for that?

If you get loose from the tether you need to be recovered by the crew; we were extremely careful with the tethers. Every tool is tethered and every piece of equipment is tethered; we were extremely careful to follow a very strict protocol so as to not get detached from the orbiter or lose anything.

«The Shuttle has lots of maneuvering capabilities. We always work in pairs. In case of an emergency of getting detached, the Commander was to maneuver the orbiter to the astronaut floating away, even if this meant damage to Hubble, and the other astronaut would grab his colleague. Priority would be to recover the astronaut.»

What sort of tools and crew aids do you use on the space walk to service the Hubble?

«A lot of them were power tools to tighten or loosen bolts. Our main power tools are the Power Ratchet Tool and the Pistol Grip Tool. They could be adjusted to a certain torque. We used power tools because there were a lot of bolts to undo in order to open doors – to save time and to better control the torque for each tightening or loosening of screws. Some tools were just normal tools modified for space usage.

«When you work in weightlessness either your body is floating free, with one hand secured on handrails built into the Hubble to position your body, with the other hand free to do some work. If you want to use both hands we stow our feet on a small platform of the robotic arm, which gives us good positioning capability for the body.

«We always had one astronaut on the platform and another maneuvering freely outside the telescope on hand rails. We also could install portable foot restraints on the go, if needed. There are anchor points on the Hubble to install foot restraints so that you can put your feet there and have both hands free.»

How do you manipulate tools with those thick space gloves?

«These gloves are inflated at 4.3 pounds of oxygen pressure, so the gloves are quite rigid. We are impaired in our ability to do work, so for many tasks we need tools. We trained for fine work with tools using the gloves. On the Hubble there are small connectors too fine to be tightened or loosened with gloves, so we had wrenches and other tools which were aids in performing these tasks.»

What is your impression of the view of space from the Shuttle, when you had breaks to take it in?

«Views of the earth and the universe were stunning. We spent some time, the only time we could relax, looking out the window. We darkened the cabin so we could see better, and for instance the passes over South America were spectacular. And the Magellanic Clouds, the Southern Cross, Alpha Beta Centauri and a totally unobscured view of the Milky Way were extremely beautiful. We could see city lights on Earth [the Hubble is on a low earth orbit, 330 nautical miles]. The beauty was really the sky, particularly the Milky Way.»

What is the environment like when you are in one of those space suits?

«The Shuttle travels 18000 mph or one revolution in 1-1/2 hours, or 5 miles per second. In space there we are close to limit of the ionosphere; it's nearly a vacuum. The space suit has a temperature control system with water circulating in small plastic tubes; it cools you down – metabolic heat is cooled. We also have drinking water we can have with a straw inside the helmet. If you didn't have a space suit, your body would nearly explode because outside the pressure is zero. There would be a huge rush of air out of your lungs. Your body would be ripped apart by a rapid swelling.»

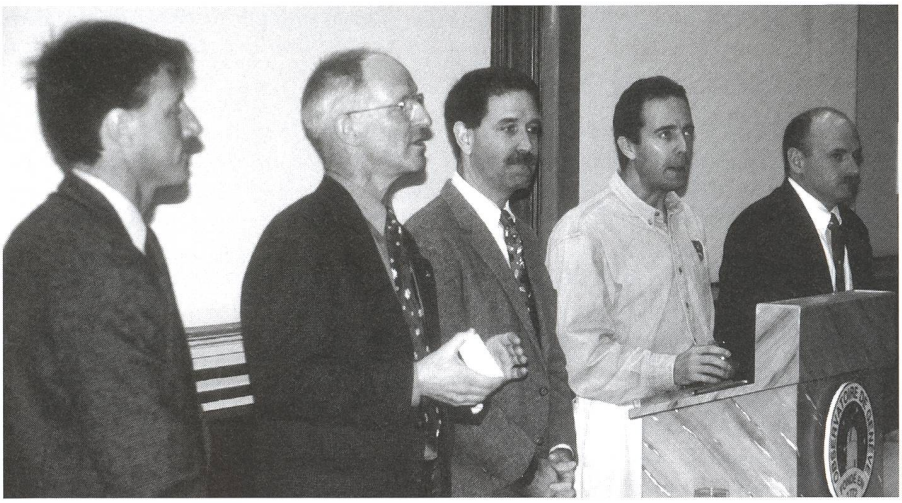
What was the most dramatic incident of this mission?

«We always expect snags. There were valves on the Hubble's NICMOS [Near Infrared Camera] that we needed to undo – they were cryogenic fluid valves – the cryo cooler had run out. It was Steve Smith's task to open the valves. The fluid valves are inside the telescope, hard to reach, and were much tighter than anticipated, possibly due to exposure to extreme temperature changes, and engineers anticipated we would have difficulty.

«The problem was that we knew the break value for each bolt we were working on. If a bolt didn't work we had to use a higher torque; to release a number of fasteners we sometimes have to increase the torque, but these valves required a certain torque much higher than expected, which means the fasteners could end up breaking. So it was very tense undoing the cryo valves and took more time than anticipated. We didn't break any bolts, but that possibility made for tense moments. If we ended up breaking any bolts it's not a disaster because we could still fasten devices shut with less than the full panoply of bolts.»

What was it like sleeping on the Shuttle? Did you sleep well?

«We sleep in sleeping bags. All seven of us sleep at the same time. Each of us had found a spot on the flight deck or mid-deck. They are pretty ordinary sleeping bags, with a cushion for your head with a velcro band to put on your forehead to keep your head on the cushion – or else your head will be floating. But some people like to sleep free floating in the cabin, and every so often they might softly bump into the wall – a soft bump that



From the left: MICHAEL FOALE, CLAUDE NICOLLIER, JOHN GRUNSFELD, JEAN-FRANCOIS CLERVOY and SCOTT KELLY describing their mission (photos: NOËL CRAMER)

won't wake you up. I slept really well. I seemed to get by with less sleep than on the ground.»

How do you shave and shower on the Shuttle?

«There's no shower! We have soapy wet towels; we wet them with a water gun; and we have dry towels; we use wet and dry towels. And we use electric shavers. Brushing our teeth, we just expel the toothpaste into a paper towel. There's trash receptacles for wet things. Toilets have an engineering system that helps to flush down waste.»

What's the food like?

«It's mainly dehydrated, and we rehydrate it with water. We generate water on the Shuttle by the fuel cells. The fuel cells produce electric power and water, so we have a lot of water on board. Dehydrated food doesn't spoil and takes much less room and mass. Most of the food is pretty good. You can compose your own menu a few months before launching.

It must have been very unusual spending Christmas working in space!

During Christmas we had taken with us Santa hats, and had a short voice communication with out families; essentially Christmas was deferred until post landing. For us it was a normal day of work. We really spent Christmas with our families after landing. There's no quarantine period after landing, but there is prior to lift-off so we are not exposed to potential sources of getting a cold or the flu.»

On this mission the Shuttle landed at night. What danger does that pose?

«About five minutes before landing the Pilot, Scott Kelly, takes manual control of the Shuttle and lands it. The entry is essentially automatic until that last five minutes before landing. The pilot takes over right after the Shuttle slows to subsonic speed. During re-entry it slows down by high drag; the whole entry is an exercise in the management of drag. This crew was trained to land at night.

Why is the Shuttle launch always postponed if there is rain or if there are clouds? Ordinary aircraft aren't usually delayed unless there are severe weather conditions.

«The Shuttle can't go through rain on ascent because rain can be damaging like bullets on the relatively fragile tile surface. And in case you have early problems on ascent you have the ability to come around and land the Shuttle, so you need to have good enough weather to land.»

How do you exercise on board the Shuttle?

«Mainly I do cardiovascular exercise and muscle toning exercise because in weightlessness muscles aren't being used naturally. You need force so muscles don't sustain too much atrophy. To maintain physical fitness in space we had an exercise machine – a bicycle ergometer; it's a bicycle which gives you a certain torque on the pedals, or you can exercise the upper part of your body on it. For this mission we didn't use it much because we were so busy, and our space walks gave us lots of exercise.

What are your hobbies?

«I love photography, flying aircraft, and spending time with my family. We like to travel to South America and Asia.

What are your duties now, after having completed this recent mission?

«Right after the flight we are recycled into a new job assignment. We have debriefings and public affairs work, lectures and such. Then I'll probably be assigned to the EVA (extra vehicular activities) where they think we can be of help. The EVA is where new technology is developed to improve efficiency of the Space Shuttle. As an astronaut they want input and recommendations from the experience I gained on this servicing mission. This is of interest in planning future flights. Astronauts help develop more efficient tools. For instance, astronauts from Hubble's first servicing mission in l993, of which I was a part, helped develop a smaller, more efficient Pistol Grip Tool, which has since been used successfully on several missions for the International Space Station. Also we are consultants to scientists who want to design space experiments: As astronauts we advice these people how to design their experiments to function in the peculiar environment of space. We give advice to the engineers and scientists on all the user interfaces, even regarding control knobs.»

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