**Interview with Dr. Chiaki Mukai**

**December 1, 2023**

**1. Could you please start by telling me a little bit about yourself and your international experiences?**

**Mukai:** My educational background is as a medical doctor, and then I became an astronaut, joining the space program. Now I work at a university, in the educational field. I started my astronaut career in 1985, and I was an astronaut for about 30 years. I worked in the space program, and then I started working in education. I think I started working for this university around 2015. In terms of international experience, when I was working as an astronaut, I did all my training in the U.S. and Europe, because my training as well as the rockets belonged to NASA, so working as a representative of Japan in the joint program with NASA was an international experience.

The IML-2 mission in 1994, that is the 2nd International Microgravity Laboratory mission, was a joint program between the U.S., Europe, and Japan, so I worked internationally with many engineers, researchers, astronauts and so on. Then, my second flight, in 1998, was the STS-95 of the Space Shuttle program. STS-95 was the 95th mission of the Space Transportation System, and it was a space medicine-related flight, so it was a U.S.-centered flight, but a joint collaboration between Japan and the U.S. We conducted research with the NIH, the National Institute of Health, which is a research center. In addition, since 2005, I have been a visiting professor at the International Space University, ISU, in Strasbourg, France, where I have taught subjects related to space life, space medicine, space operation, and space science to about 100 students from about 30 countries around the world, including African, European, and Asian countries, and also to Japanese students.

After that, I came back to Japan in 2007, and I became the Director of the Space Medicine Center at JAXA, the Japan Aerospace Exploration Agency. At that time, as Director, I organized various research projects and experiments with international astronauts (the research subjects), international scientists, engineers from the U.S., and so on. At that time, I also worked for the United Nations in Vienna, in the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). The COPUOS headquarters are in Vienna, but the U.N. has offices in several locations, such as New York and Vienna. I did this work for about six years, and for about two years I was the chief of this committee, so I was involved in international coordination with diplomats and space engineers from various countries. That's about the extent of my international experience.

For the space program, international work is essential. Because without any international ideas or international cooperation, the space program cannot be done. Especially for astronauts, we have to depend on the U.S. rocket system, and also on the Russian rocket system for transportation. And also, the laboratory orbiting on the lower orbit, the International Space Station, is internationally developed, internationally used, so “international” is a keyword for us.

**2. In broad terms, how much time have you spent working with Japanese organizations and with international organizations?**

**Mukai:** So, it's very difficult to define. Basically, I lived in Houston in the United States for more than 20 years, and I lived in my hometown in Japan, in Gunma Prefecture, for only 14 years. So, the Houston experience, living in Houston, far exceeds the time in my life that I spent in Gunma, and also in Japan. For 30 years, I was based in Houston, but I travelled to many places. Even when I came back to Japan, back in 2009, I started as a director of the Space Medicine unit in JAXA, but I still needed to travel to many places worldwide, so half of my life is either on the airplane or outside of Japan. It’s very difficult to define how long I stayed in certain areas.

**3. Throughout your career you have worked closely with other doctors, astronauts, engineers, researchers, and educators, both in Japan and abroad. Could you tell me a bit about any similarities or differences that you noticed in team dynamics when working mainly with a Japanese team and mainly with a diverse international team?**

**Mukai:** Basically, they are truly diverse teams. To unite a team, to make a diverse team one team, everybody is so energetic to work on the issues that we need to work on. There is a strong sense of responsibility and commitment. For example, when we go to space, everybody calls it a “mission”, right? And we use the word “mission”. Everybody dreams of completing the mission beyond 100%. Everyone wants to complete it, preferably to beyond 100%, complete it to 120%, which is great. We all love our jobs, and we know what we have to do. That is not only the team of astronauts. The astronauts are the tip of the iceberg, which is very visible, but there are many people under the iceberg surface, such as engineers, schedulers, and scientists. Also, the Space Agency and other people like them work together with pride in their responsibilities to complete the mission successfully.

**Hofmeyr:** So, it’s not so important where they come from; there is a common goal to achieve, so everybody works towards that common goal.

**Mukai:** I think “common goal” are very good words to understand the dynamic of this kind of team because everybody shares common goals. That's why, even if there are some disputes, even if there are some different ideas, still you think as a whole - “What is the common goal of this team?” Then, we can work together. Of course, we actively discuss the issues, and we do not always agree with other people's ideas, but still, as a whole, we can make it happen.

**4. What strategies have you used for effective scientific communication in the international teams that you worked with?**

**Mukai:** Basically, you always have to make sure that what you want to say or what you can hear is clear enough to understand each other. Science communication is much easier than literature. In science communication, because there's the terminology, you always have to make everything simpler compared to seeking valuable expressions like in literature. So, for instance, in English you can say “this train travels faster than such train.” Words like “train”, “travels”, “I have”, the verbs “be” and “have” are very short. The shorter, the better, especially when astronauts are communicating with the Mission Control Centre and the Space Station, as well as with Air Traffic communicators - the shorter, the better. Resources are very limited, including time. So, for instance, when time is limited, to send a lot of information, sentences are very short and simple, in a way that anyone can understand, to avoid miscommunication. If we don’t express it this way, mistakes will be made.

So, for science, the strategy is simplicity. I mean simplicity compared to, for example, diplomacy and international diplomacy, where there is the possibility to insult a country’s way of thinking through words. In that sense, diplomacy, in the United Nations, as well as English and strategy for diplomats, is much harder than for scientists. For scientists, it's simpler, because even if scientists cannot speak English very well, English is basically our common language. That’s why I said English, but for example, even if you don’t speak English, the formula “1 + 1 = 2” is universal. No matter what the language is, no matter what the culture is, the strategy for science communication is “the simpler, the better.”

**Hofmeyr:** You mentioned that when you're in an international team, English tends to be the common language of communication, so people from different countries can use English as an international language. When you work in Japanese, is it similar? Is it also very short? Or do you think that there’s a difference in the way that communication occurs in Japanese?

**Mukai:** Hum... in English, the verb comes after the subject, right? So, for example, when you say “I go”, you can mean “I go to the park” or “I go to my parents’ house”, but you can at least understand my actions, right? In Japanese, however, the verb comes at the end, with various things in between the subject and the verb, so you don't know whether I am saying "I will go to my parents’ house tomorrow at 10am” or “I will not go” until the end of the sentence. Because of the long sentence, you don’t know if I'm going to take the train or the car tomorrow, or if I'm going to my mother's house or not. So you may think I'm going, or you may think I am not going, but the information is at the end of the sentence, so you have to listen until the end or you will not know. There are also times when we omit the subject in Japanese, we don’t have to say “I”. But English is very logical, so in sentences such as “I go to the park at three o’clock”, it is the details that come at the end, and that is kinder. So for example, when I communicated from Earth or from space, not to make any mistakes to the best of my ability, I tried to speak in clear, shorter, sentences with the verb at the beginning.

**5. Can you think of any examples of very successful communication experiences in an international or intercultural environment?**

**Mukai:** This is a very difficult question. There is always communication, sometimes it’s very successful, and sometimes it’s not, the same as in our native language. So, to just pick one example, that is very difficult. I don't remember any one exact situation, because sometimes it goes well, sometimes it doesn't go well, but most of the time we try to make everything go well, so most of the time it goes well.

**6. Have you faced any challenges leading diverse national and international teams? You mentioned you've been in several director and advisory as well as teaching positions, so are there any challenges that you can think of specifically in terms of leading these diverse international and intercultural teams?**

**Mukai:** Many people think that international and cultural differences are big, but they are not. When you are working, the differences, coming from an educational background, or as medical doctor, the culture is different from that of the engineer. And that’s also different from the culture of people who were raised in military groups, military civilians. Due to the joint work of the space program, one type of pilot astronaut comes from the military. No matter what the military subgroup is, like Air Force, the Army, or Navy. And, in the military, Air Force, Navy, those different subgroups have different subcultures. And then the people with a military background have a different culture from scientists. Artists are also different, right? But those diverse people need to work together towards “one goal” or a “common goal”. So, to achieve the common goal, different people talk from different viewpoints. That really makes the organization or teamwork difficult, but also interesting. And then, it brings the team to a higher level.

Because different people have different ideas, sometimes I feel, “Oh, I didn’t realize that way of thinking about this one thing.” Finally, everybody needs to reach an agreement. How do we do this? We have a common mission, a common goal. So, finally I agree, but even before I agree, I heard different ideas and talked openly. During the discussion, I may say, “Oh no, I don't think you are right, your idea is not good, or it doesn't work” or something like that. But in the end, we work together, and the idea starts becoming clearer to everybody. Or I thought it didn't work, but now I feel ready, like, if we add this idea, it may work much better than I thought, or something like that, and then we reach an agreement. That's all that we did. So, that's the benefit of diverse people, diverse teams, because we always say that you can change the same idea, but you cannot learn from the same idea. You can only learn something new from a different idea.

**7. Have you faced any challenges returning back to Japan after spending a significant time of your life abroad?**

**Mukai:** Just physically, in terms of space. In Japan everything is cozy, small and you are used to it - when you go to lunch, when you see the lunch. After coming back from Houston, I always thought, "Wow, is this the Japanese size of a lunch? It's almost half the size of Houston,” so I have to order two. Something like that. So, the portions and the sizes are small. For example, I have a very small house that had a lot of construction work done, and there are very beautiful flowers planted. It is such a small place, but Japanese people are so neat. And people are so small, the Japanese people compared to the white Caucasian people and the big guys, so I thought “wow everybody is so small!”

**Hofmeyr:** Those are easily noticeable differences. What about moving from field to field, did you notice any challenges or any big differences, moving from the medical field to space to education?

**Mukai:** Of course, it's very different. The different fields have different cultures, if we just call it culture, like the medical field. Even in the medical field, operational medicine is totally different from the basic research medicine. But what I can say to the students is, whatever you want to seek, and there may be things you like, if you like something, think about what you like to make your dream happen. Professionally, I worked as a medical doctor for 10 years. This means that, at least, I can say “medicine is such and such and I love medicine.” I was really proud of myself working in this field. I can claim that medicine is my profession. If you can say with pride that, “my profession is such and such,” or “I’m very fond of such and such,” or “I'm very good at such and such,” it gives you confidence. Once you reach the point to say, "I love it, I really made it in my profession," or something like that, it gives you confidence.

Then, using that confidence, expand yourself by exploring different areas. In my case, I actually became a medical doctor because I wanted to help people suffering from diseases, so occupational medicine. Ten years I worked as a doctor. And then later, I moved into the space program. And then, even in the space program, it's not totally different because under the space program, what I did was human exploration. When humans are in the center, you need medicine or medical devices or medical ideas or human communication, human relationships. You need some psychology or that kind of information that you have learned previously, so use the previous experiences to move on to the new area. Then you can expand yourself.

To convey to students a motto I like, I would say “if you can dream it, you can do it”, and also “education enables you, enables us to envision our dreams”. So, it is very important to dream, and a dream is a goal, and it is important to have a goal, and if you have a goal, you can make your dream come true. However, if you don't get the proper education and skills to make your dream come true, your dream will end up being just a dream. I think it is important to make your dreams come true through education, starting from the bottom. When you do it this way, what you learn about yourself and about the world will expand. Life is very short - you can only live for 100 years, and 100 years is very short. But you can enjoy your life two, three, four times as much. Your life’s duration will be the same, but if you can expand your activities, and you get to know some different worlds, then your life expands. And I think that you can enjoy your life three times as much.

**8. Are there any specific attitudes, knowledge, or skills that you think are necessary for students who are considering living or working across cultures in the future?**

**Mukai:** Basically, love people. Meet a lot of people, exchange ideas and, for example, if there are different cultures, put yourself in the shoes of someone from a different culture to understand the world. That is a totally different world. I really enjoy it because it is different. I can learn many new things from a different culture, from different people or people who I have never met. If you love other people, then those people will love you, so communication becomes much more enjoyable.

**9. Can you think of any strategies that you have acquired through your experiences that can help prepare students in Japan for the future, especially in medical and scientific careers?**

**Mukai:** Right. Students may not understand how important the things that they are learning every day are, how they are connected to the future, to the real world. School is just school. School is the boarding area. Whatever you learn from school or is simulated in school needs to be actually tested in the real world, which is society. So, whatever the discipline, including in science, you always have to make a connection between what you are learning right now and how it may be useful for such and such. If you have some dreams for the future, you think “I may be able to work for the people or work for society with such and such knowledge or skills that I am currently learning.” Then, you can cast back to your life and, coming back to reality, “Oh, what I have to do is such and such, or tomorrow I have to do this because 10 years later, I may use this skill or idea or connection or friendship.”

 Maybe young people, the students may think that time, life, is unlimited, but it is not unlimited, it's limited. I'm a medical doctor and before that, I was a medical student. So even when I was young, I faced children, young people who unfortunately died from diseases or injury or traffic accidents. Nowadays, if you think about the Ukraine or if you think about Gaza, now you are healthy, but tomorrow you don't know if your life will continue or not. If you are currently living in Japan and also getting some adequate education (because if you think about the world, in some countries, even if you want to learn, you are not able to get equal educational opportunities), if you have the opportunities to learn, that is your tool. You have to be armed with education because that opportunity is given to you. Time is so limited, then you have to enjoy your life, or use up your life completely, beyond 100%.