Tape Recorded Interview – Edited January 28, 2011

Interview with Dr. P. Krishna Rao, former NESDIS Chief Scientist, at his home in Rockford, MD.

Interviewer: Doria B. Grimes, Senior Analyst, Riverside Technology, Inc.

Dr. Rao: Sig Fritz started the Meteorological Satellite Section in 1958, and it was part of the U.S. Weather Bureau. In a very short time, the organization expanded and became the Meteorological Satellite Laboratory and Fritz was the director. When TIROS-1 was launched, the newspapers, (e.g. The New York Times and The Washington Post, etc.) started calling him for interviews and information. He was very involved with the Science and interpretation of the satellite data and did not have time for other activities. He requested Dave Johnson to take over the organization. As soon as the meteorological community had the opportunity to see the satellite data (originally the images only), they realized the positive impact of the data and wanted the data to be provided for immediate operational use. With the addition of infrared channels on the follow-on TIROS satellites, the impact of these observations for weather analysis and forecasting became obvious, and the demand for these satellites to become operational was imminent. The name of the organization changed to National Weather Satellite Center. Dave and Sig Fritz should be given the credit for starting this important organization.

D. Grimes: So when did Fred Singer come into the organization?

Dr. Rao: Very soon the TIROS satellites were playing an important role by providing important observations for weather, climate, and other applications. The satellites were providing data for national and international use, so they brought in Fred Singer who was a well known space scientist to head the organization. Fred stayed with the organization for a short time[1] and suggested some modifications to the satellite configuration and left.

Meanwhile the name of the U.S. Weather Bureau also changed to the National Weather Service and it became part of the Environmental Science Services Administration (ESSA[2]). With that, the name of the satellite organization also changed and it became the National Environmental Satellite Center (NESS). Dave Johnson again became the director[3] and Sig Fritz was the Chief Scientist. (He did not want any administrative duties.)

In fact, Dave Johnson was the one who saved me from being thrown away, because I was still an Indian national. I was not even an immigrant. Thirteen months after they employed me, they found out that it was a mistake. So Dave Johnson who was a member of the National Space Council raised this issue to Vice-President Lyndon Baines Johnson who was the Chairman, and requested help to get me an immigrant visa and eventually USA citizenship. The request was granted immediately!

---

[1] 1962-1964.

[2] ESSA became part of the Department of Commerce in 1965.

[3] April 1, 1964.

D. Grimes: Dave Johnson would do a lot of this quietly.

Dr. Rao: That's right, but he and Fritz would ask very tough questions. You had to satisfy them. Once you satisfied them, they took care of how to get money for the budget and things like that. In order to get the funding he wanted to know why we needed this. There were two channels in the first radiometer and we wanted three, four, and five. So I walked into Dave Johnson's office and he said, "Why is it that every time you walk into my office, it costs me millions of dollars."

Once you go there and tell Dave it would be good for the organization. Dave was a scientist and he had so much support from the Congress. He was very credible. George Brown[4] used to be the Congressman at the time from California. Dave was from California.

Sig and Dave trusted a few people. You would go there and talk to them. They would ask questions, but they were not threatening. They'll always be prodding, asking why we had to do this. Once you convinced them, that's it. They would back you up 100% of the time. No doubts. Nobody can touch you, and also, they were for the organization. They were not looking for any outside laurels.

D. Grimes: Dave Johnson was genuinely sincere from what I read.

Dr. Rao: In fact, all my life and at my retirement, I said, "My existence here is because of Sig Fritz and Dave Johnson." They didn't want me to go anywhere. Just stay right there. When somebody from the National Science Foundation offered me a promotion, they said, "You stay right here." So I stayed there with them. I enjoyed that. We don't have people who are dedicated to the organization now days.

[pause]

In 1974, I went to Geneva when they created a position to coordinate the 4 space superpowers (U.S., Japan, European Space Agency, & Soviet Union). It used to be in the World Weather Watch Department at WMO. They had a position. The Russians wanted it. The U.S. wanted the job. But I ended up as a compromise candidate between the two countries. Without asking me, Dave Johnson suggested my name. When he returned to Washington and after a staff meeting, he asked me, "How about spending a couple of years in Geneva?" I said, "You don't like me here?" He said, "We want you to coordinate all the four space powers and I think you can do the job." So I went there and I told him that I would spend only two years. I came back on July 31, 1976. It was a two year thing. Gordon Cartwright, Science Counsellor at the U.S. Embassy, was there. He and Dave were good buddies. Every day at two o'clock in the afternoon, Gordon Cartwright would come and see me. All the other international guys were concerned about what we were talking about.

D. Grimes: So why did Dave retire in 1982? He was at the top of his game.

[4] George Edward Brown, Jr., (March 6, 1920 – July 15, 1999) was a Democratic member of the U.S. House of Representatives from California from 1963-1971 and 1973-1999. He was known as a champion for science.

Dr. Rao: Even in the mid 70's, he used to tell me he was going to retire in 1982. He had been telling a few of us when he was going to retire and he retired in the year he projected.

D. Grimes: Dave was 28 years in the government and, if you add his military, it was enough to retire with full pension.

[pause]

Dr. Rao: I was asked to take him to pick up an Award in 2000 as an Honorary Member of the American Meteorological Society. He said, "I can't travel." So they decided to give it to him in Washington, DC. So I had to go to Annapolis and pick up Dave to receive his award in Washington. When I saw him, I felt so bad. Dave said, "I can't tie my tie." So I tied his tie, and took him to the meeting. I felt so bad.

[pause]

Dr. Rao: Verner Suomi. We used to sit down in a Chinese restaurant and he would scribble on those napkins. "This is what we should do."

The Joint Cooperative Institute is one of our ideas, to have the first one at the University of Wisconsin and then go to other states where we can have interaction with the university people and recruit the students. Dave Johnson was in favor of it. The first one was at the University of Wisconsin. We relocated some of the best people. A lot of people take credit for it. They asked, "By sending people, are we going to delude our work force?" I used to say, "No. I think our best should be teaching there and then look for the bright kids and bring them on board." Bill Smith[5] was the first one.

D. Grimes: I interviewed Bill Smith and he gave me his testimony which is online.

Dr. Rao: Bill is retired now I guess. He was very enthusiastic. He went overboard saying we wanted 16 AVHRR channels. I used to say, "Bill, don't go that far yet. Let's slow down." Sometimes Dave Johnson said, "I think Bill goes too far. What do you think?" We are good friends and I can't say Bill is bad. He is a very fantastic scientist, but he was a very eager and wanted to go all out to do it. I said, "Slow down." We can't get money for this kind of thing.

The problem was in the old days we had to prove we can do a lot with what we had, and we cannot do certain things because we do not have the additional channels. I used to say that if we had those three or four additional channels, we would have mapped the ice content, vegetation, and drought. So I used to say that the capability goes down. When I showed the sea surface temperatures and eddies that were forming along the Gulf Stream, they said, "It sounds like science fiction." Now it is a reality. We showed that it was essential.

[5] Dr. William L. Smith, Jr., My Remembrances of David S. Johnson, January 20, 2010.

D. Grimes: Dave also thought ahead. In one of his interviews[6], he said that someday you will be able to see the weather "all of the time" from your wristwatch. Is that not what people do today with their BlackBerries, iPhones or iPads?

[pause]

Dr. Rao: The satellites. We had to explain to them in a way they could understand why we needed two of each, one and a backup.

D. Grimes: That is one thing that Gary put in.

Dr. Rao: Well, they had failures and we didn't have that many backups. We got the backup satellites because of the failures. Some of them did not go into orbit. They were needed for severe weather type of thing and they made Tornado Watch, and things like that.

D. Grimes: Then Dave sent you to Geneva.

Dr. Rao: After Dave left, I worked for John McElroy[7] for two years without a title, and later became the Director of Research and Applications. For twelve years I was there. After that, Jim Baker[8] wanted to re-organize and they wanted a Chief Scientist type of a thing. I was Chief Scientist for NESDIS. They changed it to Senior Scientist now. Now it is Dr. Stan Wilson. He was the AA of NOS and is an oceanographer. He came from NASA Headquarters. I have known Stan for a long time. He was in the Naval Oceanographic Office too.

Regarding NPOESS[9] and similar former efforts, the Department of Defense didn't want to coordinate. It was a "leave us alone" type of thing because of the restrictions. The NESDIS thing is to share the data with everybody. DSMP wouldn't share the data. The National Academies were opposed to the whole DoD partnership. I think Dave and even John McElroy didn't want the NPOESS thing.

Dr. Rao: I am not pessimistic. I am getting wiser with the world.

D. Grimes: In NPOESS, they were building a Rolls Royce and trying to keep everyone happy. The cost over-runs, and that's what killed it.

Dr. Rao: It was a lot of things and is a sad thing.

---

[6] Johnson, David S. NOAA Satellites: Working For You, A broadcast interview with David S. Johnson, Director of the National Environmental Satellite Service. Rockville, MD: NOAA, vol. 8, no. 4, October 1978, pp. 50-51.

[7] Dr. John H. McElroy (1936-2007) was the NESDIS Assistant Administrator from 1982-1986. See transcript of interview in Reunion of NESDIS Administrators, tape 2, p. 1-2.

[8] Dr. D. James (Jim) Baker was the Under Secretary of Commerce for Oceans & Atmosphere and Administrator of the National Oceanic and Atmospheric Administration from May 1993 - January 2001.

[9] NPOESS – National Polar-orbiting Operational Environmental Satellite System.

D. Grimes: They made Gary temporarily as "Acting Director" of JPSS[10], the newest version.

Dr. Rao: Gary, system-wise, has the in depth knowledge. Nobody else in-house can do it.

In the old days I used to visit the calibration thing at the RCA lab in Princeton, New Jersey. Very few people were going to the calibration facilities to see if they were doing it right.

Today, it is a whole new generation of people. The contract monitor has to understand the science. I am not a systems guy. I raised the issue on the calibration, visible channel calibration is going to be tough. Sig Fritz used to really bug me on the visible channel. The light bulb was used as a source of light. Light bulb filaments get aged. So when they calibrate an instrument, how long did it take at that point in time because the same bulb after 14 to 15 days is different.

Then they used to use photographic paper as a reflector. Photographic paper ages with time. Is it really white? Is it yellowish? So these are visible things. Calibration is a very tough thing, so some of us had to go to New Jersey to the RCA labs in Princeton to Abe Schnapf to verify things.

D. Grimes: Abe Schnapf[11] was the big guy from RCA with the TIROS series.

Dr. Rao: I am not criticizing. I feel that this is the only organization that provides data for the world.

The colors that we see every day in the news, our guys developed that in the lab. The press used to come to the World Weather Building that had all the TV cameras. We developed the color images you see on TV. I think the cooler ones should be greener and the warmer ones more red. Dan Rather said, "Please don't change the colors. The public likes it." It is not the way I would like to see it. Red means hot. Anyway, now everybody has their own enhancement.

D. Grimes: We now take it for granted.

Dr. Rao: The Vegetation Index is a NESDIS product. In fact, they were worried about the wheat crop and the Vegetation Index came up. The Russians bought wheat from the U.S. You remember the Russian wheat deal of 1972? They did that a long time ago, because no one was monitoring what the wheat crop looked like all around the world. When the Vegetation Index came up and we were looking for funding, Dan Tarpley, myself, Stanley Schneider, and Russell Koffler were there. Felix Kogan came in later. The Vegetation Index monitors the crops all over the world and they were predicting a shortage. The Department of Agriculture imposed a restriction on the issues until late Friday afternoon because the stock market was reacting to it. AgGRISTARS[12] was the program and the four of us started the

[10] JPSS – Joint Polar Satellite System

[11] Abraham Schnapf (1922-1990) was the Project Manager for RCA Astro's TIROS series and subsequent generations of weather satellites.

[12] AgRISTARS is a joint satellite remote sensing program initiated in fiscal year 1980. It is a cooperative effort with the U.S. Department of Agriculture, NASA, NOAA, the Agency of International Development, and the U.S. Dept of the Interior. It uses the advanced very high resolution radiometer (AVHRR) instrumentation on board NOAA's Polar Orbiting Environmental Satellites.

program. The administrators wanted to be realistic and asked why we were asking for 1.56 million dollars. Following our explanation, they said, "O.K. you have it."

For this project on the channels on the polar satellites, we split up the visible channels, short wave, and expanded to other channels, infra-red which is sensitive to chlorophyll radiation. The near-infra-red was to be on a new satellite, but no one gave us money to do these things. We were doing this as a research thing using what was on the satellite. The Vegetation Index became an operational product.

No one expected that sea surface temperature would become operational. There was no money for a radiation budget. We used one of the channels on the simple advanced AVHRR and showed how you could do it. That is why they have a continuous record for over thirty years from 1964.

I have not been in touch with the ozone hole over the South Pole. The satellite showed very low values in 1982 but out scientists ignored that, thinking they were "noise". When the British scientists noticed very low values of ozone, our scientists reprocessed the data and confirmed the findings. Now the tapes are at NCDC and NASA and have been reprocessed for long time records.

D. Grimes: So the Data Centers did not routinely keep the satellite data.

Dr. Rao: It had to be re-processed. The calibration thing changes and re-processing is necessary. NASA spent some money, but this re-processing is not a one shot deal. The more they understood about the calibration, they had to go back and reprocess all the data to get the climate details. That's expensive to go back and re-process 34 years of data. MSU data, microwave sounding units, that is used for arguing climate changes.

All satellite data have to be reprocessed for climate work. The calibration of the satellite sensors changes with time and it has to be monitored. Also new knowledge is gained about the various contributions from the atmospheric constituents (e.g. aerosols, clouds, etc.) and appropriate corrections have to be made. John Christy[13] in Huntsville has shown the impact of these on the Microwave Sounding Unit data for climate analysis.

D. Grimes: Did Dave come to your house?

Dr. Rao: He did before but not after his retirement. He did not come to the house after his retirement.

D. Grimes: I read that he was made "Acting" in a number of positions before his retirement.

Dr. Rao: Dave did not complain. He was also Director for the National Weather Service for a time. Then he was "Acting DAA". Internally, he trusted a small circle of people. We would usually meet in the hallway and we would be talking. He was very accessible but he was reserved.

He trusted, but he asked tough questions. Sig Fritz did the same thing. Fritz used to come in at 7:15 in the morning and he would sit in my office. He said, "I don't want to answer the

[13] Dr. John R. Christy is a noted climate scientist at the University of Alabama in Huntsville.

telephone. Your office is quiet." This is your boss's boss, but I worked with him. He asked very tough questions, but at the end of the day, he said, "O.K. No one will give me any trouble anymore." He wanted to make sure we were on the right track.

Art Johnson was the deputy for internal management. Those three guys were a good team. They started the Satellite Experimental Lab as a part of NOAA.

Regarding NPOESS, there were too many kinds of requirements and also too many instruments they wanted to put on these things, some of them tested and some of them untested.

D. Grimes: To re-cap, when you came here, there were 30 to 35 people.

Dr. Rao: It was the Meteorological Satellite Laboratory. When I came, it was Sig Fritz who hired me and when I joined, it was Dave Johnson. That was in 1961.

D. Grimes: Thank you for your time.