STAMATIOS M. KRIMIGIS

LUNCHEON AT THE WHITE HOUSE: ON COMETS AND THE PLANET URANUS

The following "Notes to the File" summarize the events at a luncheon meeting held at the White House in March 1986.

The "Poor Man's Comet" videotape being shown by S. M. Krimigis, chief scientist of APL's Space Department. (Until recently, he was a member of the National Academy of Sciences' Space Science Board and chairman of its Committee on Solar and Space Physics.) Others at the table (clockwise) are E. C. Stone (California Institute of Technology), F. L. Whipple (Harvard University), F. L. Scarf (TRW Systems), J. Svahn (Assistant to the President for Policy Development), D. T. Regan (White House Chief of Staff), President Reagan, A. H. Kingon (Cabinet Secretary), and J. P. McTague (former Acting Science Advisor to the President). Not shown but present were E. Morris (Historian), T. V. Johnson (Jet Propulsion Laboratory), and J. C. Brandt (Goddard Space Flight Center). (White House photograph by Bill Fitzpatrick)

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
LAUREL MARYLAND

March 26, 1986

To: File

From: S. M. Krimigis

Subject: Lunch with President Ronald Reagan
in the Roosevelt Room of the White House
12:00 Noon to 1:00 P.M., March 26, 1986

Reference: Invitation telegram, dated March 13, 1986 (attached)

The purpose of this luncheon was to acquaint the President first-hand about the discoveries, developments and break-throughs in specific disciplines of Science and Technology from scientific leaders in their respective fields. This luncheon was to focus on comets and the planet Uranus. The scientists involved were the following: Fred Whipple - Harvard University, Ed Stone - California Institute of Technology, Fred Scarf - TRW Systems, Jack Brandt - Goddard Space Flight Center, Torrence Johnson - Jet Propulsion Laboratory, and S. M. Krimigis - Johns Hopkins Applied Physics Laboratory.

Meeting at Science Advisor's Office

We gathered at about 11:00 A.M. in the office of John McTague, Acting Science Advisor to the President, at the Old Executive Office Building on the White House Grounds on Pennsylvania Avenue and 17th Street, Room 358. Dick Johnson, Assistant Director of the Office of Science and Technology Policy for Space was present and we had a general discussion on the points that each was going to cover and the most appropriate sequence to follow in the discussion. One of the points that John McTague made was to say a few words to the President about the future directions in each one of these research areas. Each of us had brought some mementos to leave with the President. Ed Stone had brought a set of Uranus pictures; also, he and Torrence Johnson had brought two framed pictures, one of which was a blow-up of a Miranda image that showed the twelve-mile high cliff. Jack Brandt brought a picture, also framed, of Comet Halley observations from Earth showing a tail disconnection event that took place, I believe, in the course of twenty-four hours from January 10 to 11, 1986, with an overall scale of about 5,000,000 miles. He also brought a framed picture of the UV intensity profile of Comet Halley obtained by the Pioneer Venus spacecraft in orbit around Venus. Fred Whipple brought a copy of his recently published book on Comets, and two or three pictures from the European Giotto spacecraft showing the active jets as well as the nucleus of Halley's comet. Fred Scarf brought a tape of sounds from Uranus, including the impacts on the spacecraft as Voyager crossed the ring plane, chorus from gyrating electrons, and sounds associated with Miranda. I brought three pictures of the Christmas Comet from the AMPTE spacecraft and also of the comet release on July 18, 1985; in addition I had the artist's view that we had just put together of Uranus' magnetosphere.

On to the White House

We left the Old Executive Office Building with John McTague and walked into the White House about a quarter of twelve and were guided into the Roosevelt Room, which happens to be across from the Oval Office. The room is fairly good size and had a long oval table with seating for twelve people, six on one side and six on the other. On the wall, on the right-hand side as one walked in there were paintings of Teddy Roosevelt on his horse as well as his portrait; on the left-hand side there was a very life-like portrait of Franklin Delano Roosevelt. Across from the open door of the Roosevelt Room one could see the Oval Office which was guarded by what appeared to be a Marine Guard and we were able to go by and take a look and see all the furniture inside as well as the shape of the desk. A TV monitor was in the room and was intended to show the tape of the first man-made comet which I had brought with me, with a person there who was to tell by telephone the operators of the equipment in an adjacent room the exact time when I needed to use the tape. Also there was a TV crew that was preparing to tape some of the session and a photographer who apparently accompanies the President most of the time. By the way, John McTague, the Science Advisor, said that the President is photographed roughly about 200 times a day.

As we stood waiting for the President to come in, we were asked to stand on one side of the table so that the President would come in and meet each one of us while the photographer was taking pictures. A few minutes after twelve, the President walked in followed by Don Regan, his Chief of Staff, and others whose names I'll mention, and he came around and met each one of us and asked our names and the photographer was taking pictures as he came along and shook hands. I was seated at the end of one side of the table, across from John McTague, the Science Advisor, and the Secretary to the Cabinet, Al Kingon who was next to the President. On the other side of the President was Don Regan, and a gentleman by the name of Jack Svahn, who is Assistant to the President for Policy Development. At the very end of the table was seated the President's biographer, Mr. Edmund Morris, who is apparently accompanying the President to all the meetings he has with Government officials and the public. Next to me was Ed Stone and next to him, Fred Whipple, right across from the President.

The Luncheon

After we all sat down, Al Kingon, the Secretary to the Cabinet, stated that the purpose of this luncheon was to acquaint the President with recent developments in Science and Technology and that they have had previous sessions with astrophysicists, scientists working in genetics, and scientists working on robotics. After this introduction Fred Whipple presented the President with his book and began to tell him about comets and how strange such objects are and proceeded to show him a couple of the pictures of Halley that were obtained by the European Giotto spacecraft just two weeks ago. He tried very hard to point out the jets and talk about the nucleus and the President was looking at the pictures very intently and he seemed to be curious about where the nucleus of the comet was; Ed Stone came to the rescue and pointed out that the dark part is the one that was thought to be the nucleus and at that point Fred Whipple pulled out a sketch which showed the

nucleus to be an irregularly shaped object which was somewhat oval, and Fred Scarf joked as to whether this was a peanut or a potato and there was general laughter around the table.

I forgot to mention that when Fred Whipple was talking, Don Regan wanted to know if the gases from these cometary objects had any influence on the environment of the Earth and the Earth's atmosphere; Fred Whipple and Fred Scarf noted that they probably didn't have any impact even though in 1910, during the last Halley perihelion, the Earth did go through the tail of the comet and that a lot of quacks were selling medicines which were supposed to protect people from gases from Halley. At that point the President remarked that "you don't suppose that those who were not born in 1910 but rather in 1911, the gases might have had some ill effects on them" jokingly, and Fred said "Well they might have had some beneficial effects, Mr. President."

Mr. Regan then asked how many times have there been close encounters of comets or other objects with Earth in recent times. Fred Whipple responded that there had been several, and referred to the impact in Siberia in 1908, the passage of several asteroids, and the most recent close flyby of an asteroid over Yellowstone in 1976. The President remarked that if there were an impending collision with an asteroid, all countries would forget their differences and unite their efforts in trying to figure out what to do. This, he said, would show that all humans are like brothers. Fred Scarf responded that in science we are already working together, like brothers.

We then began to discuss the age of comets and of the universe, and the President said that he wanted to tell us a story about the professor and the students:

> "Once there was a professor who was explaining information about the solar system to the students and about the fact that in a billion years or so the sun would run out of fuel and everything would grow cold and the Earth would freeze. This was quite impressive to the students, and after some respectful silence, one of the students raised his hand timidly and said 'Professor, tell me how long did you say that would be' and the Professor said 'Oh about a billion years' and the student said "Whee, I thought you had said a million years!"

We all laughed at the joke and he proceeded to tell us how he would go out at night as a kid in the midwest, look at the stars, and wonder whether there was anyone living out there. He then asked "you gentlemen have investigated a lot of things in space; have you found any evidence that there may be other people out there?" We responded that we had not found such evidence, whereupon the discussion then returned to Comet Halley.

Fred Scarf then pointed out that in fact this was not the first time that a spacecraft had approached a comet; it was a U.S. spacecraft called the International Cometary Explorer (ICE) that approached comet Giacobini-Zinner in September of 1985 and, even though it did not have a camera, it

obtained a great deal of data that was most illuminating. Fred proceeded to show a picture of the path of the spacecraft through the tail of Giacobini-Zinner and pointed out that it took ICE only about an hour to traverse the comet's visible tail, but that in fact Giacobini-Zinner activity extended to at least 100 hours on either side of the nucleus, showing that the influence of the cometary plasma extended to a great distance from the comet, as far as about 5 million miles. Jack Brandt then stepped in and mentioned that the comet encounters had excited a lot of activity throughout the world including some participation by U.S. scientists in a program called the International Halley Watch and showed the President a framed picture with the ground-based photograph of Halley on January 10; then a piece of the tail of Halley being torn away by January 11 and pointed out the enormous scale of this activity namely that it was at least 5 million miles long. Fred Scarf pointed out that in fact we had just begun to see activity from Comet Halley from the International Cometary Explorer, even though that spacecraft was about 20 million miles away from Halley at the present time.

At that time I said that I would like to change the subject slightly and tell the President about the "Poor Man's Comet" namely one that was man-made at very high altitude from Earth, and it was a cooperative program between the U.S., the Federal Republic of Germany, and the United Kingdom. I asked then that the tape be run on the monitor and it came on the screen right on schedule. I showed the President the orbits of the U.S., German and British satellites and pointed out where the artificial comet explosion took place, and then that we took these pictures with a high-altitude camera on an airplane that was flying above the cloud cover; I noted how we actually could see the tail of the comet forming from the barium cloud that was initially released, that the experiment had been quite successful, and that we had saved enough gas to repeat it on the 18th of July 1985 which was shown on the second part of the tape; that we had learned a great number of things, including the fact that not a single tail is formed but rather more than one tail in both cases and that the blobs of this material were being torn off the main comma and blown downstream to form the tail which in the case of the July 18 comet was about as long as ten thousand miles. I also pointed out that the beauty of this experiment was that it allowed the spacecraft to be right within this cloud and make unique measurements which are not possible to make with a natural comet, as we had heard earlier; and that it had provided data which are absolutely essential in interpreting the observations of the European and Soviet spacecraft which made observations of comet Halley from a substantial distance. The President seemed to be very interested in what he was seeing. Don Regan asked how much barium did we actually release to make the artificial comet and I said that it was about a couple of kilograms.

At this point Ed Stone discussed the planet Uranus and its atmosphere; the President wanted to know whether it was pronounced Uranus or Uranus. He said that when he was watching coverage on network television during the encounter by Voyager he couldn't make out which was the correct pronunciation and we all said that Uranus is the correct pronunciation and that's what this shall be from now on. Ed Stone pointed out how one side of the planet is always pointing at the sun, at least around this time of the

solar system. He went on to explain the blue appearance of Uranus by pointing out that the red part of sunlight was actually absorbed by the atmosphere and the blue part was reflected because of the presence of methane in the atmosphere of Uranus, but that most of the atmosphere consisted principally of hydrogen gas. Ed then showed the President pictures of the rings, noted that they are very different than the ones that Voyager observed at Saturn and that in fact the differences in the two ring systems are not very clearly understood.

At the end of Ed Stone's presentation, Torrence Johnson spoke about the moons, pointed out that he had been a moon-person all these years, and showed a mosaic of Miranda which, as we all know, looks as if it has very different terrains from various parts of the solar system put together. Torrence pointed out that we did not have a theory of how this could be explained but that Dr. McTague said before lunch that this was obviously a moon that had been put together by a committee. Everybody had a good laugh at that. Torrence pointed out that the dark and shiny places show that Miranda as well as some of the other satellites are made partly of rock and partly of ice, that some of it was water ice and some probably was methane ice. He showed one particular cliff that is very prominent in one of the Voyager pictures and pointed that this was a cliff 12 miles high in an object that was 300 miles across, indicating that Miranda may well have been broken up sometime in its history by tectonic activity as well as flows, and it may have been assembled together from the various pieces. The President said that when he was growing up he remembers that when people talked about the Earth's moon that as you looked at it, it had a lot of what seemed like ice and snow on it and he wondered whether there is any such thing on the moon. We responded that no, there was no ice on our moon although it is conceivable, but not likely, that in the lunar poles in regions which are permanently shielded from the sun, there could be some ice that may still be present, but we won't know that unless we go around the moon in a polar orbit.

After that point we had a general discussion, the theme being that of how important exploration of the solar system was, not only because it is state-of-the-art technology that always pushes the frontier but also because it gives people a sense of participation. Ed Stone pointed out that when Galileo first discovered the moons of Jupiter, nobody could actually see them unless they went to Galileo's telescope and looked through it. These days with the communications systems that are in existence, when we send a spacecraft such as Voyager to a planet everybody can participate because when the pictures come back the general public sees them at the same time as the scientists do. This is a way for the public to share in the discovery and it is particularly important for young people and students who are thus attracted to scientific careers. He also pointed out how much we learn from studying other planets because of the fact that for example, the weather patterns on Uranus, where the pole is always facing the sun, is very different from that at Jupiter, Saturn, and Earth where the planets are rotating with their axis perpendicular to the ecliptic. It was said that by studying the other planets we can actually learn a lot more about the state of our own planet and gain understanding on how systems operate on Earth. Then we got into a discussion on how tilted the magnetic field axis was with respect to the rotation axis and Ed pointed out that in the case of Uranus the magnetic field is tilted at

some 60° which is very different than all the other planets. I then chipped in to make the point better that if you had a compass on Uranus and wanted to get to the North Pole, you would actually end up in San Francisco and the President got a big kick out of that (actually it's more like Los Angeles).

Ed Stone then pointed out how long the Voyager program had been in the planning stage and that when we first started working on the program we were all relatively young; it was well over fifteen years ago and here we are visiting another planet and hopefully will visit Neptune in 1989. At that time I said, "Well, Mr. President I have to tell you a story I heard from Tom Paine, the Chairman of your National Commission on Space, just the other night. As you know these planets only line up every one hundred and seventy five years and that is what made this project possible; we used the gravitational pull from one planet to go to the next, and then that to go to the next one, and so on" and I said "Dr. Paine pointed out that when he came to get approval for this project from President Nixon he pointed out to him that this alignment of the planets had last occurred when Thomas Jefferson was President, and that Jefferson blew it!" At that point everybody broke up and laughed heartily.

By this time it was one o'clock and the President said he couldn't leave without telling us this other story:

> "the story has to do with the time when the children of Israel were leaving Egypt and they were being chased by the armies of the Pharoah and were in fairly desperate shape; at which time Moses decided to go and talk to God about what should be done next. God said "Well Moses, I have some good news for you and I also have some bad news" and Moses said "well Lord, tell me the good news first" and God responded that "the good news is that I have arranged to have a column of smoke during the day and a pillar of fire during the night to guide you in the right direction; not only that, I have arranged that when you all get to the Red Sea, I will part the waters so you can all walk across the Red Sea and furthermore, once you get on the other side, and the Egyptians get into the Red Sea in pursuit, I am going to let the waters come back together." Moses then said: "Well Lord, that sounds absolutely wonderful, but tell me what is the bad news?" so God said, "the bad news is that you are going to have to file an Environmental Impact Statement!"

So we all had a good laugh and then the President thanked us for being there and said how wonderful it was to have the opportunity to live in an age when all these technical advancements were possible and how wonderful the space exploration program was and that he hoped we would have more and more excitement as time went on. The President actually did not end the meeting himself, it was Don Regan who said "Mr. President, I have to remind you that we are behind schedule and you have another appointment." Up to that time Mr. Reagan was having a good time with all of us and asking questions and so on. As he was preparing to leave, he looked at the pictures we had brought him which he had carefully stacked at his side. He then said how nice of us it was to have shown him these pictures and "did we need them back?" We all

said we had brought these for him, whereupon he thanked us profusely, tucked the pictures under his arm and left the room

Back to the Science Advisors' Office

We then left the White House and walked back to the Old Executive Office Building. John McTague was very pleased, he thought the whole thing went exceedingly well and that we were "a bunch of professional actors" for having put all of this together; Fred Whipple allowed as to how we have been giving talks about this sort of thing and by golly we had better be good at it. McTague, nevertheless, thought that it went especially well and it couldn't have gone this well if it had been scripted. I pointed out to him that it could not possibly have gone this well had it been scripted. We went back to the Science Advisor's Office, picked up our things and left.

That was the end of a memorable day at the White House. The weather was absolutely superb outside, it was in the 70's, spring had come and a lot of people were all over the streets around the White House, down at the Lincoln Memorial, the Washington Monument grounds, and the Ellipse and it was a rather festive atmosphere throughout the city.

SMK:pj

P.S. My secretary reminded me that I did not tell what we had for lunch. There was soup (a clear liquid, some sort of consommé), salad, roll & butter, with ice tea. The main course was roast beef (very tender) with some vegetables; the dessert was a piece of chocolate cake. Surprisingly, the President did not have the main course, but ate a sizable piece of chocolate cake, while the rest of us were working on the roast beef. Afterwards John McTague explained that the President skips the main course in trying to keep his weight down.

The fresh floral centerpiece on the table consisted of orange tulips and yellow daisies. The seating arrangement during the luncheon is shown below.

Krimigis	Stone	Whipple	Scarf	Brandt	Johnson
McTague	Kingon	Reagan	Regan	Svahn	Morris

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ON BEHALF OF PRESIDENT REAGAN, I WISH TO EXTEND TO YOU AN INVITATION TO A SMALL LUNCHEON MEETING WITH EMINENT ASTRONOMERS AND PHYSICISTS ON WEDNESDAY, MARCH 26, 1986 AT 12:00 NOON IN THE ROOSEVELT ROOM AT THE WHITE HOUSE.

THIS WILL BE THE FOURTH IN A SERIES OF LUNCHEONS WHERE THE PRESIDENT HEARS FIRSTHAND FROM LEADERS IN SPECIFIC DISCIPLINES IN SCIENCE AND TECHNOLOGY ABOUT THE DISCOVERIES, DEVELOPMENTS, AND BREAKTHROUGHS IN THEIR RESPECTIVE FIELDS. THIS LUNCHEON WILL FOCUS ON COMETS AND THE PLANET URANUS.

YOU SHOULD PLAN TO ARRIVE BY 11:00 A.M. AT THE OFFICE OF SCIENCE AND TECHNOLOGY IN ROOM 358 OF THE OLD EXECUTIVE OFFICE BU9LDING AT 17TH AND PENNSYLVANIA AVENUE. PLEASE R.S.V.P. AT 202/456-2800 AND PROVIDE YOUR SOCIAL SECURITY NUMBER AND DATE OF BIRTH.

ALFRED H. KINGON
CABINET SECRETARY

1213 EST

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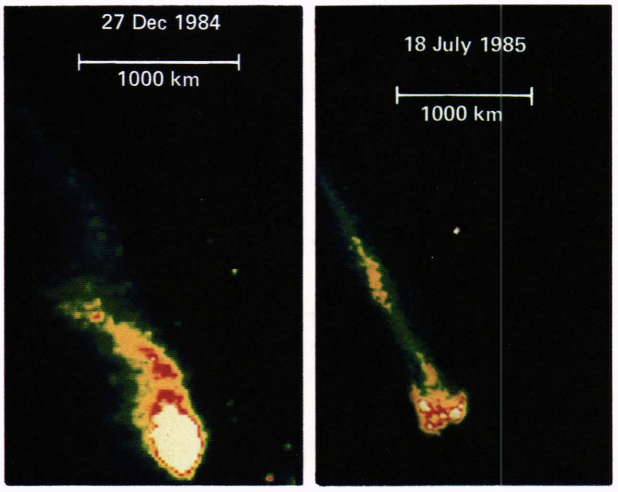
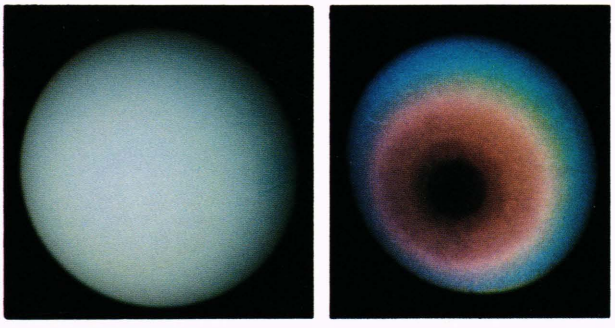
Early March 1986 marked the beginning of a series of encounters with Comet Halley by an international armada of spacecraft and the start of what has been called by J. C. Brandt of NASA's Goddard Space Flight Center "...the greatest week cometary science ever had or is likely to have for quite some time." Included in the armada were the European Space Agency's Giotto spacecraft, Russia's Vega I and II probes, and Japan's Suissei and Sakigake spacecraft. Most ambitious was Giotto's closest approach to within a few hundred kilometers of Halley's highly active nucleus. Giotto's most notable achievement was its survival and its successfully resolved imaging of the nucleus in a very hostile dust environment.

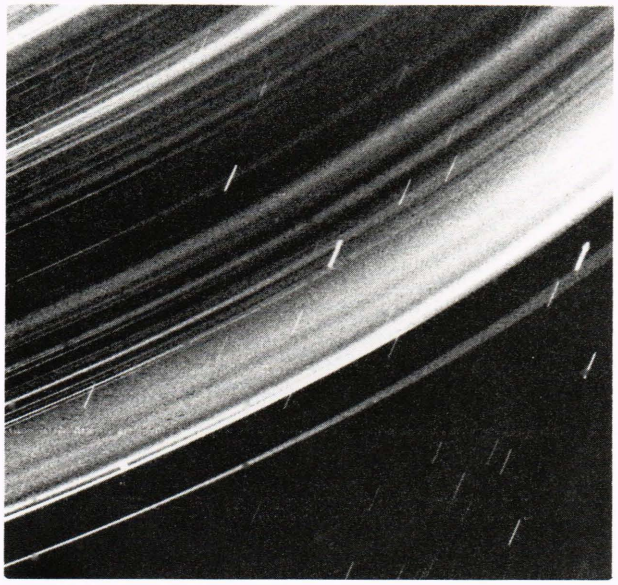
This image shows Halley's nucleus as a dark peanut-shaped object about 14 kilometers long from which bright dust jets are emanating. Giotto's cameras, which were developed in an international cooperative program led by the Max Planck Institute for Aeronomy, use a Texas Instruments charge-coupled device sensor.

In a collaborative project among the United States, the Federal Republic of Germany, and the United Kingdom, the AMPTE (Active Magnetosphere Particle Tracer Explorers) program started with the launch of three satellites on top of a Delta rocket in August 1984. APL is the Principal Investigator institution for the U.S. part of the AMPTE program. One of the mission's objectives was to simulate the interaction of cometary-type gas with the solar wind by releasing barium atoms at high altitudes, outside the influence of the earth's magnetic field. The first opportunity for such a release was in the early morning of December 25, 1984, over the western United States, with the press dubbing the release the "Christmas Comet." Because of poor weather, the experiment took place on December 27, 1984. Pictures were obtained from a high-altitude aircraft with Max Planck Institute for Extraterrestrial Physics cameras, operated by A. Valenzuela. A second release was made on July 18, 1985. A videotape of both releases, prepared with the help of R. Grauel and his staff at APL, was shown to President Reagan and his staff during the luncheon.

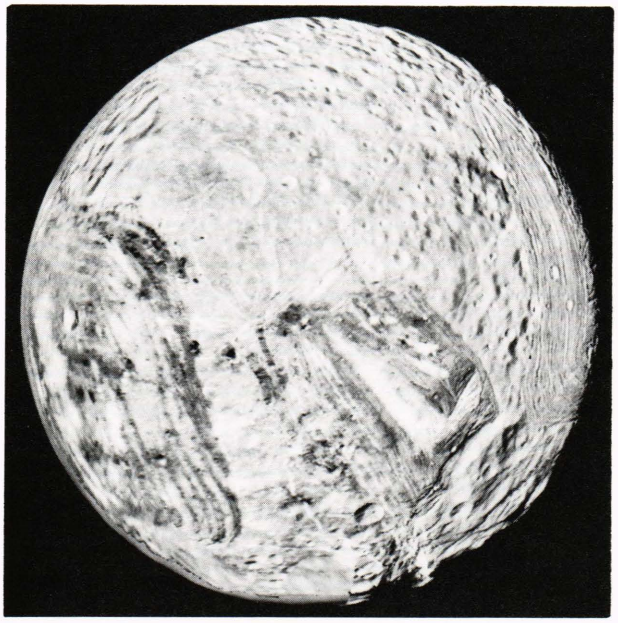




These pictures of Uranus—one in true color (left) and the other in false color—were compiled from images returned January 17, 1986, by the narrow-angle camera of Voyager 2. The spacecraft was 5.7 million miles from the planet, seven days from closest approach. The picture at left has been processed to show Uranus as human eyes would see it from the vantage point of the spacecraft. The darker shadings at the upper right of the disk correspond to the day-night boundary on the planet. Beyond that boundary lies the hidden northern hemisphere of Uranus, which currently remains in total darkness as the planet rotates. The blue-green color results from the absorption of red light by methane gas in Uranus' deep, cold, and remarkably clear atmosphere. The picture at right uses false color and extreme contrast enhancement to bring out subtle details in the polar region of Uranus.



This dramatic Voyager 2 picture reveals a continuous distribution of small particles throughout the Uranus ring system. Voyager took the image while in the shadow of Uranus, at a distance of 147,000 miles and a resolution of about 20 miles. This unique geometry allows us to see lanes of fine dust particles not visible from other viewing angles. All the previously known rings are visible here; however, some of the brightest features in the image are bright dust lanes not previously seen. The combination of this unique geometry and a long, 96-second exposure allowed this spectacular observation.



This computer-assembled mosaic of Miranda includes many of the high-resolution frames obtained by Voyager 2 during its close flyby of the Uranian moon. Miranda, roughly 300 miles in diameter, exhibits varied geologic provinces, seen in this mosaic of clear-filter, narrow-angle images from January 24, 1986. These are among the highest resolution pictures that Voyager has obtained of any of the new "worlds" it has encountered during its mission. On Miranda, ridges and valleys of one province are cut off against the boundary of the next province. Probable compressional folded ridges are seen in curvilinear patterns, as are many extensional faults. Some of these show very large scarps, or cliffs, up to 12 miles in height—much higher than the walls of the Grand Canyon on Earth.

This high-resolution image of Miranda was acquired by Voyager 2 on January 24, 1986, at a distance of 22,500 miles. In this clear-filter, narrow-angle image, Miranda displays a dramatically varied surface. Well shown at this resolution of 2000 feet are numerous ridges and valleys, a topography that was probably produced by compressional tectonics. Cutting across the ridges and valleys are many faults. The largest fault scarp, or cliff, is seen below and to the right of center; it shows grooves probably made by the contact of the fault blocks as they rubbed against each other.