

David W. Swift, *Voyager Tales: Personal Views of the Grand Tour*. Reston, Virginia: American Institute of Aeronautics and Astronautics, 1997, 438 pages including photographs and an index.

This is an extraordinary book, written by an exceptional person. David Swift is a Professor of Sociology at the University of Hawaii and one of a small handful of social scientists concerned with the human side of space exploration. Since this is not one of the traditional career paths toward academic fame and fortune for a sociologist, Swift has often had to struggle against inertia, disinterest, and outright hostility. But he has persevered, to our advantage.

This book reflects Swift's courage and creativity both in terms of what is attempted and how. The volume is composed of basically verbatim transcripts of interviews which Swift conducted in the mid 1990s with thirty-six of the roughly three thousand people responsible for the conception, design, launch, and all other aspects of the missions of the Voyager 1 and Voyager 2 robotic spacecraft over the many years of the project's duration. The project officially began in 1972. The two Voyagers went on a "Grand Tour" of four of the planets of the outer solar system--Jupiter, Saturn, Uranus, and Neptune--following liftoff in 1977 though planetary encounters during the late 70s and throughout the 80s, and a final "Family Group Portrait" of the entire solar system, photographed by Voyager 1, then four billion miles away from Earth, in February 1990.

The entire project was fortuitous. The "Grand Voyage" itself is only feasible once every 175 years, or so, when the planets come close to "lining up" for relatively easy flybys. If the trip had not been taken when it was, it could not have occurred until the 22<sup>nd</sup> Century. And it is not likely to have been undertaken before it was since Thomas Jefferson was President of the US the last time the planets had lined up so neatly and our space program was somewhat less well-developed then, Neptune having only recently been discovered and Uranus still unknown.

In addition, the opportunity for a Grand Tour came just as the Apollo Moon missions were ending, and just before the shuttle

operations were fully underway. That might seem like perfect timing for something as grand as the Tour, but in fact, the Grand Tour concept itself was officially rejected by NASA because of budgetary (and perhaps also scientific) reasons, as well as a philosophy which basically favored manned missions over robotic ones. Indeed, the persons responsible for Voyager were able to obtain money from NASA (and Congress) for only a two-planet mission (Jupiter and Saturn). However, by using the now-common, but then-problematic, “gravity assist” technique (obtained by swinging a spacecraft back by a large planetary body and using the gravity of the planet to slingshot the craft farther out into space), Voyager’s managers were able to fly by four planets (and more) for the price of two.

The story is also exceptional because JPL (Jet Propulsion Laboratory), the branch of NASA responsible for the Voyager missions, was (and probably still is) itself remarkable in institutional structure and managerial philosophy, and thus permitted a team of highly qualified and yet basically compatible experts to work together over the extraordinarily long period of years on this single, sustained project. People of course came and went, and there were clashes of personality from time to time (and some broken families in the process) but if one thing comes through loud and clear from the interviews, it is how extremely committed the people involved in the project were not only to the project itself, but also to each other. In every interview, Swift asked the respondents what the highlight of their time on the project was, and over and over again each respondent said that there was no single event, but rather that the overall experience of working with the other people on such a daunting and pioneering project was their continuing “highlight.”

Never has the human side of any long-term project been more clearly revealed in its centrality and importance than it is in this volume. I strongly recommended anyone who wants to understand in detail what makes for a successful long-term, multi-disciplinary project to read this volume carefully. While good science and technology is obviously necessary, caring and careful management is the primary key.

Finally, the volume is extraordinary in terms of who Swift interviewed—and that choice itself reveals a great deal about Swift himself. Not only did Swift talk with many of the major actors—from Gary Flando, who, as a graduate student, first recognized the possibility of a Grand Tour (though he still may not be sufficiently applauded for that), and the various Project Managers involved from the Development and Pre-launch phases, through each of the planetary encounters and now on its Interstellar Mission (Bud Schurmeier, John Casani, Robert Parks and the rest); two JPL Directors; and the various head Engineers and Scientists. One would expect them to be interviewed.

But what makes this volume exceptional, and David Swift an extraordinary social scientist, is the fact that Swift also interviewed a Photo Lab Supervisor, a Head Dispatcher of (ground) Transportation; a person responsible for print documentation; a security chief; a Visitor Control Greeter, a Project Secretary; a Telephone Operator; and a public information officer, and included their comments in full.

It is normal in our celebrity-crazed society to focus only on the big-shots without whom of course none of this would have been possible, and to overlook all of the little folks, without whom, of course, none of this would have been possible either.

The Photo Laboratory Supervisor, Robert Post, said this in his interview:

“But I would like to have the photo lab get some kind of recognition. We’re the ones who did it. ... This is Neptune, that’s Uranus, and here are two of Saturn. I’m the one who put those together. These pictures are actually cut out and pasted down. That’s the art work that was photographed. That’s exciting for me. Now that I think about it, that’s sort of a high point, because I put those things together and I see them published. I see them in magazines and newspapers and book jackets and record covers. There’s no indication whatsoever of who put these together, who made them. Nobody knows. But I know. I did. Now, how many artists would give their left arm to have their artwork published like this? I’ve done something that practically everybody in the world has

seen. That is personally satisfying. At first I tried saving them every time I saw one on a magazine cover and put them away in a box, but I finally gave it up because it got too big, too heavy, too much.” “I still see them. You open an ad for K Mart and there’s a television set and on the screen there is that Saturn image.” “It’s hard to believe it was me that was involved in it. I never planned on this. Never thought about doing this as a living. I didn’t know what I was going to do. It was all handed to me on a silver platter. ‘You want to work here?’ I said, ‘Sure’. ‘Okay, go up and talk to so-and-so.’ I did and 33 years later I am still here. Doing this. I can’t imagine doing anything else.” (335f)

The result of this catholicism on Swift’s part is not just some warm and fuzzy human interest tale (though that was pretty warm and fuzzy, wasn’t it?). Rather, all of these interviews not only make clear what is necessary to undertake a project like this successfully but they also reveal some interesting facts which might otherwise have remained concealed.

For example, early in the book, Charles Kohlhase says:

“Let’s face it: our moon is not that exciting a place, right? It’s just a dry, airless, cratered, somewhat dead body. What if we had seen 30 moons like ours? We’d have been a little bit disappointed. But we didn’t. We saw Jupiter with its turbulent atmosphere with all the colors in it.... The solar system had more diversity than people had imagined.” (p. 87)

That is certainly true. No one knew for sure what the photos of the outer planets, and their moons, would reveal. Suppose they had been mostly dead and barren, like our own Moon? And what were their true colors? Judgements had to be made continually when developing and printing photos from the Voyagers about how to set the colors on the photos as they were being prepared.

Consider what Robert Post says again:

“If we get an image of, say, one of the moons of Jupiter or Saturn, we don’t know what the colors are supposed to be. So we leave it up to the Imaging Team to set those parameters.” “If we

print to that gray scale the way we're supposed to print it, the imagery on that film will be exactly what it's supposed to be according to the scientists. Then they can come over and look at it, and they may tell us it's not quite right. Then we can make the color correction, with somebody from the Imaging Team looking at it and saying, 'Add a little blue, take out a little yellow.' Then, when it's exactly the way they say it is supposed to look, that image is locked into place color-wise, and that's how we will print it for press release. Once it's released as that color, it must never be changed because we're also printing for science people too. If we sent out a picture of Saturn, say, that looks just exactly the way Brad Smith says it's supposed to look, and it's this particular color, and then next time we print that negative, somebody prints it a little greenish, and it goes off to some other scientist, and he compares that with the other scientist who got a yellow one, then there is a lot of explanations of why mine is green and his yellow. So once a color is established for a particular image, it has to stay that way, and we can't vary from it, no matter when it's printed." (331f)

Throughout the interviews with the project managers, engineers and scientists, much is made of the objectivity of science and the subjectivity of politics. The project was so successful for so long, it is said, because basic decisions were made objectively—in hiring, firing, managing—and not by playing favorites or by allowing organizational (as well as national) politics to intervene. That is probably the case overall, but it is interesting to learn about some of the subjective decisions which were made which still now literally color our images of the outer planets, and of deep space.

A recent issue of Discover Magazine had a brief article by Bob Berman titled, "Colorizing the Cosmos." In it Berman says:

"For more than 20 years, space agencies have embellished images of the heavens. Some of the images have to be enhanced: Photos assembled from wave-lengths beyond the eye's perception have no color, so researchers paint them any way they choose."

Then more to our point here, Berman remarks:

“False color, for the sake of drama, got a lot of reinforcement when the giant outer planets were photographed during the Voyager mission in the late 1970s and 1980s. Researchers intensified color and contrast to maximize detail, and the media fell in love with the brilliant images. When Voyager 2 reached Neptune in 1989, the previously pale planet was promoted to sky blue with red tinges. Uranus was—and still is—presented as lime green. No scientific principles justify these embellishments. Uranus is featureless. Without detail to enhance, the planet needed a rich new color to get the attention of the press” (September 1999, p. 50).

Yes, science is objective and politics is subjective, but boy, is it difficult sometimes to tell one from the other.

These are just a few of the many nuggets in this book which reveal how big science and engineering is actually done. David Swift is to be congratulated for letting everyone tell us in their own words how it really is.

In *Technological Forecasting & Social Change*, 2000