

NASA ORAL HISTORY PROJECT

ORAL HISTORY 2 TRANSCRIPT

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INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is January 8, 2003. This oral history with Courtney Stadd is being conducted in Washington, D.C., for the NASA Headquarters History Office, Administrators Oral History Project. Interviewer is Rebecca Wright. Mr. Stadd is currently the NASA Chief of Staff and White House liaison. This session is a continuation of the January 7, 2003, oral history that focused on Mr. Stadd's involvement in commercialization of space.

We ended yesterday's session talking about the Office of Commercial Space Transportation, which was an office that was created to be the office in government to address the range of complex issues affecting companies entering the field of space commerce, as well as to assist large manufacturers trying to learn the commercial game. Under your tenure, do you believe you were able to accomplish those expectations?

STADD: As I look back from the perspective of 2003, I would say that I think we did actually a pretty good job in that office, of walking that balance. At the same time, it's clear that this is still a work in progress. You know, the commercial industry, to a large extent, is still in the first inning, and we by no means have achieved the vision a lot of us had twenty-five, thirty years ago, a fully robust commercial private sector, from the launch industry to Earth observation, GPS [Global Positioning System] communication, communications being certainly the one exception. On the other hand, there have been an awful lot of entrepreneurial Iridium-type initiatives

proposed, that have been stillborn or at least semi-stillborn. So there's still a lot of potential in the communications area as well, let alone the vision that called for space-based factories, and so forth and so on.

So the jury is still out as to what the potential is for that industry, let alone the extent to which government is doing the appropriate thing in terms of supporting and encouraging and providing the appropriate level of regulation versus promotion for this industry.

In terms of specifically the launch industry, given the fact that in the mid-eighties we were on a very steep learning curve, in terms of putting in place the licensing regime that would provide the type of expedited licensing that the commercial industry was calling for, at the same time protecting the public safety, frankly, I think we did a pretty good job of putting in place the checks and balances that were necessary.

In large part, we benefited from the Air Force experience. Now, of course, the Air Force was exclusively concerned with their government requirements, their national security requirements, and so to some extent there was a bit of an apples and oranges there. But nonetheless, it did give us a baseline to start from. Then, wearing our civil regulatory hat and recognizing the importance of a timely regulatory response to the industry, I think we came up at least with a set of regulations and a set of presumptions behind the licensing regime that were pretty responsive, I thought, to that balancing act that we had to maintain.

As I look back at it, however, since, it is my feeling that the office, in recent years, which now, by the way, is housed in the FAA, the Federal Aviation Administration, has to some extent fallen prey to that very certification regulatory environment, as I mentioned earlier in the interview, we were trying to avoid back in the early eighties. And I have heard concerns expressed by industry that the licensing regime has evolved to an extent that they are

micromanaging beyond what we thought was appropriate, and that to some extent it is acting as a bit of a hindrance to the industry.

I am no longer associated with the office, of course, and really not in a position, nor do I want to be in the position, to second-guess my successors, but I do find it troubling that that type of balance that was built into the statute, that we built into the regulations, that we really took great pains to execute in the office, based on the anecdotal feedback I'm getting, appears to have veered a bit more into the regulatory micromanagement area than we had anticipated.

WRIGHT: We've talked about that this was such a new era, and a variety of internal White House entities took interest in this, including the Senior Interagency Group for Space, and the Economic Planning Council. Some of the issues they addressed were the Shuttle payload pricing, commercialization, Space Station, and this Industrial Space Facility. How would you compare the effectiveness of the multipolar approach to space policy issues to the functioning of the National Space Council?

STADD: The problem with the SIG [Senior Interagency Group for] Space was that it was very much captive to the leadership capability of the people managing it at the time, which was primarily in the National Security Council arena. We had mixed success, frankly, in the eighties, during the Reagan administration, with the different people who were managing it on behalf of the National Security Council. In most cases, they were military officers who brought differing degrees of capability to the interagency process, which really represents a unique challenge in terms of leadership. You've got diverse equities among the agencies. Oft times you've got

competing agendas among the agencies, so it takes a strong and effective hand to bring those sometimes warring factions into something resembling a consensus.

It really wasn't until the arrival of Colonel Roger [G.] Dekok, who is a recently retired Air Force general, under the leadership of then-General Colin Powell, who was President [Ronald] Reagan's Special Advisor for National Security, that, in my opinion, we really had effective leadership finally brought to bear during the latter part of the Reagan administration, the second-term Reagan administration. During that tenure, I thought we did a pretty good job of generating national space policy. You know, the critic will argue we didn't do it as timely as required. As somebody who was an active participant in it, given, again, the diverse interests and equities that had to be brought together into a consensus, I think we did a pretty good job.

But, frankly, you needed something like a National Space Council, chaired by the Vice President in that case, to really bring the level of authority, the level of enforcement, that could assure the timely disposition of interagency issues. My view is that the Space Council really filled a vacuum at the time in terms of space policy leadership, and as a member of that staff, I think that we were given the appropriate support by the administration, and I felt the agencies, by and large, were responsive. We did have some pretty controversial issues involving the State Department, among other issues. I won't kid you by claiming that we had some easy interagency dealings with the State Department, among other agencies, but I think, by and large, it was the right mechanism at the time.

In my judgment, I think, in this current administration [George W. Bush], because we have very strong leadership among the agencies, starting with NASA, I don't think you need something quite as global as a Space Council, and at the moment, it appears that between the leadership that we're bringing to bear at the agency level, combined with the targeted efforts of

the National Security Council in areas such as remote sensing, space transportation, global positioning, system modernization, that it appears to be working, for the moment. But, again, you really have to look at the circumstances that are prevailing at any given time to determine whether a Space Council-type mechanism is required.

Indeed, the Space Council has had a storied history from the Eisenhower administration through the Kennedy-Johnson administration, and then it basically lapsed, went away during subsequent administrations, and then, of course, got resurrected in the Reagan administration, and since the first Bush administration, has lapsed. And I have no doubt, sometime in the future, there may well be a call in some future administration to resurrect the Space Council.

WRIGHT: One of the items of controversy in the late eighties was the Industrial Space Facility. During unrelated testimony you were providing in a couple of those hearings for the House Science Committee, you were asked questions about this issue. Could you talk to us about that issue now?

STADD: Yes. The Industrial Space Facility was very much a part a pioneering initiative. One of the architects was the legendary Max [Maxime A.] Faget. Mr. Faget, well known to the NASA community, was one of the early designers of the Mercury spacecraft. In fact, his imprint could be felt on all the major manned spacecraft in the sixties, seventies, including the Space Shuttle. So he brought a great deal of credibility to the table when he proposed, during the mid-eighties, that he and his team could design and secure commercial financing for a shirtsleeve orbiting space station.

One of the prerequisites he proposed for this facility was that the government act as an anchor tenant. In sum, what that entailed was NASA's agreement, up front, to purchase a share, if you will, or agree to procure a part of this facility much the same way that when a real estate firm is establishing a shopping mall, they look for a name department store to be the first tenant, the obvious hope being that that tenant becomes a magnet for other tenants, and the result is, hopefully, a viable facility. That was much the same model that Mr. Faget and his colleagues were using for this Industrial Space Facility.

Needless to say, during the Reagan era, with its focus on market-led initiatives, commercialization, this was an initiative that was quite favorably received by the Reagan White House, very well received by those of us who were working in the commercial space policy arena at the Department of Commerce, the Department of Transportation. And there was a lot of sympathy for this concept at the Office of Management and Budget, particularly since it promised to save the taxpayer some monies in terms of developing a research facility in orbit. I should add that it was in no shape or form proposed to replace the Space Station that NASA itself had proposed and had been supported by the Reagan White House, but was designed to be a facility primarily focused on commercial research in Earth orbit.

Much the same way that during the Shuttle pricing debates, that I talked about earlier, engendered heated debate between NASA and the more commercially oriented agencies at the time, in much the same way the same arguments were generated during the ISF [Industrial Space Facility] review by the interagency process.

At that point, I was at the Department of Transportation. We, our allies at Commerce, people within the White House, and OMB [Office of Management and Budget], were successful in having the President specifically call out support for the ISF in an executive order, which,

when you think about it, is rather extraordinary, for a President to specifically note a specific initiative in such detail.

NASA, in my personal view, felt threatened by this ISF. Recall, please, that the Space Station had only recently been proposed, endorsed by the administration, and was still very much in a Phase A stage at that point, and the agency was probably feeling—indeed, was feeling exposed in terms of getting solid support for the Station. Of course, we know now that the Station, up until recently, has been vulnerable to support in the government, specifically on Capitol Hill, for many years until just a few years ago. And the agency really went out of its way to oppose the ISF, and they even went to the extent of going to the Academy of Sciences in trying to get a report that would suggest that the facility, as structured, was not as viable as Mr. Faget and others were suggesting.

So when I went up to testify, the House Science Committee had been sufficiently exercised by NASA and its allies, the contractors, that they were also very concerned that the ISF was driven more by ideology, more by free-market Reagan Republican ideology, than by practicality, and concerned that perhaps this was a misuse of taxpayer money and an unnecessary diversion from the efforts to support the NASA-proposed Space Station.

Of course, in our view, the ISF was very attractive, because it promised to be deployed in a relatively short period of time. There were those of us, which I count myself very much a member of, who were very skeptical of NASA's ability to build, deploy the Space Station in a timely manner. Having watched how long it took to get the Space Shuttle developed and deployed, again, we felt that the agency was probably going to be confronted with a much longer schedule and a much bigger budget challenge than they had suggested.

So when I went up to testify, the committee was very anxious about learning more details. At that point, there was still executive privilege associated with the ISF initiative that hadn't yet been, as I recall, publicly announced yet. So I was in the rather awkward position of not being able to fully disclose the facts, while at the same time having to deal with the critics on the committee, and that was a pretty interesting experience.

Unfortunately, the ISF was defeated. I think the agency and its contractors were successful in undermining its credibility, and it ultimately went away. I feel very strongly that if it had been supported, we would have had this facility in place years ago, and, frankly, I think it would have generated a robust research community that would have been eager for the larger capabilities of the International Space Station that we currently have in orbit. So I think it was a most unfortunate turn of events.

It did demonstrate at the time the nature of the rice bowls, or the vested interests that were in place, in terms of defending the orthodoxy against encroachment by outside entrepreneurs. I'm pleased to tell you that as I sit here today in my current capacity at NASA, that I do believe that the culture at this agency has profoundly changed. I believe that if an ISF was resurrected today, that there would be a much more receptive audience than we had back twenty years ago, or, I guess, about sixteen, seventeen years ago. But that's where we are with that.

WRIGHT: Well, it has almost been about twenty years since the creation of the first space commercialization legislation. What lessons have been learned from these efforts that can still be applied today, and then what issues have yet to be resolved?

STADD: There are many lessons to be learned. I think one is an adage that I have taken to heart for many years now, and it is that one has to be careful about a tendency to mistake technical possibility for market opportunity, that there are many times when one can be seduced by the technical elegance or entrepreneurial vision of a given company, but there's a long distance between that and translating that into reality.

Secondly, that there needs to be, and it's vital that there be, open communication, two-way communication, between the relevant parts of government and industry. Too often, as the commercial policies, regulations, and so forth made their way through the system, one would find that entrepreneurs and the government agencies would oft times be talking past one another. Oft times, there'd be a set of biases or prejudices that both would bring to the table. I think we've worked through some significant issues in that regard, but I think we still, from time to time, confront a tendency for the commercial industry to have a certain view of the way they think government is going to treat them or view them, that may or may not comport with the facts. And I think government people sometimes bring a set of presumptions that are sometimes mistaken vis-à-vis the industry as well.

One example is in the area of safety. When I took over the office at the Department of Transportation, there certainly, at the very minimum, was a subliminal message that one felt from NASA and the Air Force, that the private industry could not be fully trusted to ensure that the public safety was safeguarded as much as possible. In fact, I can distinctly recall interagency debates with the agency back in the eighties, when we were pushing to have the Shuttle no longer launch commercial satellites, when NASA people, with a straight face, would argue that really only the agency could handle safety and assure a safe launch. And there were a number of us who would remind the agency that even then, when you went down to Cape Canaveral

[Florida], that there were people on the front lines wearing windbreakers with “comma-Inc.” after the name of their entity, of the contractor that they were representing.

I’m not suggesting that industry should have the exclusive purview for public safety, by any means. In fact, if anything, my experiences since have only reinforced my view that the government has a fundamental and appropriate role in safeguarding public safety in the area of commercial space activities. But it is to say that industry does have its own incentives, after all, to ensure safe products, and that it doesn’t have to be as binary a situation as some of my government colleagues were suggesting back in the eighties. So that’s one example where I think more open communication might have ameliorated some of the heated debates and some of the learning curve that we had to go through to achieve where we are today.

The other challenge was the fact that commercial space is almost, by definition, global in nature. Given the nature of satellites, which orbit the Earth and have a bird’s-eye view of the planet via communications, via Earth observation, via GPS, of course, and the launch vehicles that deliver those spacecraft to orbit, you do get yourself involved pretty quickly with oft times trade-related issues, foreign competitive-related issues. So, export control turned out to be a much bigger issue that a lot of us had anticipated. We’ve also been involved with intellectual property issues to an extent that probably was not anticipated.

The other issue that was more complex and challenging than anticipated had to do with collaboration and use of government infrastructure. After all, the bulk of the commercial launches were taking place, and have taken place, from government ranges, and I think that for a lot of us, it was eye-opening in terms of the complexity.

How do you define pricing? The ’84 Space Launch Act referred to direct cost in terms of figuring out what we should charge commercial users at the ranges, but you could drive a

proverbial Mack truck, in fact, a fleet of Mack trucks, through that definition, in terms of trying to get a handle on what was exactly meant by it.

So a lot of time was spent during my tenure at DOT [Department of Transportation] in working primarily with the Air Force in trying to define pricing. I understand that those discussions continue even to this day. Again, this is another case of walking a balance between fostering an environment at the ranges that are conducive to commercial operations, which entails ensuring a stable and predictable pricing environment, while at the same time ensuring that the government is getting appropriate and adequate compensation for its support and use and wear of its facilities in support of these commercial activities, and doing that, once again in a global context, where you have to demonstrate to your foreign competition that you're not engaging in unfair subsidies that they then, in turn, can use against the United States when alleging unfair trade practices. So that's an example of the type of complexity that we probably didn't do a good job of anticipating, and have spent an awful lot of time grappling with since.

WRIGHT: You went back to the private sector for a while. What made you move back into that direction?

STADD: Well, I had dedicated more time, more years, than I had expected in public service. Frankly, when I was asked to join the Commerce Department in the '84-'85 time period, I thought it would be about a year worth of investment of time, would help to put in place some policies, and then I would return to some sort of entrepreneurial space venture after that experience. That's probably a rather profound example of the level of my naivety at the time,

but, by the way, it's a pattern that's continued with my career ever since, in terms of anticipating how much time I would spend in any government position.

But that point, near the end of '88, I had spent more time than anticipated, and I had some family issues I hadn't dealt with. My father had passed away at that point. There were some business issues, estate-related issues, that I was called upon to help deal with, and so it seemed to be a logical point for me to tender my resignation, and I handed the reins over to Carol Lane, who was an aerospace executive that I had known from her days on Capitol Hill, and she very kindly took over as my successor. I felt, at that point, that it was in good hands.

I also felt, at that point, felt good about the precedents we put in place in terms of the regulations, in terms of licensing the first set of commercial space activities, in terms of educating agencies in the government and the private sector aerospace-related entities as to the nature and scope of our charter, and the Congress. I felt that we were making some headway in terms of congressional support for the office. So I felt when I left, it was in good enough shape for me to consider other options.

So, indeed, I left sometime in '88, I tended to my family business, came back to Washington, D.C., and hung my hat at a government relations office for a while, and focused on commercial space activity.

Then I think I was involved with that for about a year, and then I got a phone call asking if I might be interested in joining the National Space Council. In fact, the current Governor of Florida, Jeb [John E.] Bush, was one of those that suggested me for the position of Senior Director for Commercial Space. I had known Jeb Bush when he was Secretary of Commerce in the state of Florida when I joined him in inaugurating the first commercial space port. It may be worth at some point talking a moment about commercial space ports.

When I was at the Department of Transportation and we were grappling with a lot of the technical challenges dealing with the national ranges, it struck me that it might be appropriate to explore establishing entirely commercial space ports, and that idea resonated with a group of people down in Florida, and one thing led to another. Secretary of Commerce Jeb Bush and his team got very interested in that effort, and NASA also, the people down at Kennedy Space Center [Cape Canaveral, Florida], were supportive, and the Air Force was supportive, and the end result was inaugurating in—I believe, again, it was 1988, cutting the ribbon with the Secretary of Commerce for this space port, which exists today at Kennedy.

That helped prompt other space port initiatives in California, New Mexico, Virginia. And, indeed, after I left the government, I was on the board of the Alaska Aerospace Development Corporation for eight years, and we successfully established the Kodiak Launch Complex [Kodiak Island, Alaska], which, in fact, is the first privately financed space port that was built on virgin territory. The other space ports, in most cases, were built on existing national range infrastructure.

But back to my exiting from the Department of Transportation. I was interviewed for the job in the first Bush administration, by the Vice President, Dan Quayle. He asked me to join the staff. I did, and that led to my working there between 1989 and late summer '92. It was my job to oversee all the policies related to commercial space during that time. In fact, I chaired the interagency Committee on Commercial Space Policy. We drafted the commercial space provisions that ultimately were part of the Bush "41" space policy, national space policy, and I'm proud to say that those provisions remained intact during the entire tenure of the Clinton administration.

I'm proud of that because I believe it speaks to the level of partnership that we encouraged with the private sector. We spent a great deal of time, between '89-'92, systematically interacting with the commercial space industry, the large companies, the small companies, ensuring that we were being as responsive as possible to their needs, factoring into our deliberations congressional concerns as well as that of other agencies. So I really do believe we put together a very compelling set of commercial space policies that stood the test of time.

One of the fundamental concerns that the commercial industry expressed back then was the need for predictability and stability in space policy, and, again, I think that the fact that we've gone almost a decade with those policies in place speaks well of the type of effort that we put into it at the time. And I think it's appropriate, by the way, that in the year 2003, we're actually reviewing some aspects of that policy in light of new circumstances, an example being the prohibition on the Space Shuttle flying commercial satellites. As I explained earlier, in the eighties, there were a lot of reasons that pushed us to support that blanket prohibition, but I do believe circumstances have greatly changed since then, the culture at NASA is far different, and the nature of the industry is far different today, and that's an example where I think it is appropriate to go back, revisit that language, and see whether we shouldn't delete it, or at least fix it so that there's more flexibility for the government in terms of what the Shuttle is flying, and, again, doing so in the context of assuring that we're not unfairly competing with private industry. But there are more than ample policies, both in the executive branch, legislative, to ensure, in my judgment, that the government is kept honest in terms of not veering into unfair competition with the private sector.

So I spent three years there. It was a period where I had a chance now, not only having worked in the academic, the industry, and the agency world, now to work at the White House

level, which again by definition, requires you to take a global view of policy development and implementation to ensure or at least assist in ensuring that the execution of our policies were done as effectively as possible.

WRIGHT: In '92, NASA had a new Administrator, and you worked as a Special Assistant to Dan [Daniel S.] Goldin as well as became the Acting Associate Administrator for the Advanced Concepts and Technologies area. If we could finish out our session today by talking about those duties and responsibilities, and what you were able to accomplish while you were there in that position.

STADD: Yes. I was keenly interested during my tenure at the Space Council in the agency's commercial space activities. In fact, there was an office at the time, Office of Commercial Activities, Code C, that was managed by an Assistant Administrator named Jim [James T.] Rose, and I'd worked quite closely with the agency during that period to give them the support we thought was appropriate.

When the new Administrator, Dan Goldin, was named, I was asked, late summer of '92, to go over as a special assistant, with particular focus on the commercial space activities. I was double-hatted. The Administrator asked me to not only continue as the Special Assistant, but also, indeed, to assist in restructuring the Office of Commercial Space programs, and merge appropriate parts with what we now call it the Office of Aerospace Technology. The resulting consolidated entity was called the Office of Space Access and Technology. The idea was to extract the relevant technology research and applications parts of Code R and marry them to a revised Commercial Space Office. The goal was to establish essentially a new program office

that would, in the Administrator's view, more effectively bridge the research that NASA is doing and facilitate industry's ability to productize the NASA-generated technology, as well as, by the way, facilitate the agency's ability to accept technologies from industry as well, so, "spin in and spin out" was the basic focus of this new office.

I worked with Greg [Gregory] Reck, who came out of this Code R, and he was made the Acting Associate Administrator for this new office. It was a very exciting time during a relatively short period of time, basically the fall of '92. We did something that was very unusual in the agency; I asked if I could take an interdisciplinary group of senior NASA officials around the country to interact with the leading-edge companies at the time, such as Apple [Computer Incorporated], IBM [Corporation], Hewlett-Packard [Company], Genentech [Incorporated], 3M [Corporation], to get best practices, see how we could apply it to this new office. Essentially, we were given the keys to the Administrator's airplane, and over a very concentrated period of time, we took our notepads at the time—laptops weren't quite as prevalent as they are today. Certainly, there was no such thing as a Palm [Pilot]. We took our pencils and notepads and visited with very senior officials.

What was interesting about that experience was just about every CEO [Chief Executive Officer] that I called regarding these meetings—just about every one was a real NASA fan from early on, and just about every one seemed to have a story where, in their childhood, they were thrilled by the exploits of NASA in the sixties, and in many cases, that fueled their interest in going on with careers in technology.

So we found an open door at every company we visited, and we brought those lessons learned back and put that into a briefing to the Administrator. He ultimately supported our

incorporating the valuable feedback we learned from our industry visits into this new office and that was very exciting.

Then the election of '92 happened and [President George H. W.] Bush "41" was, of course, defeated. I was part of a very small group of political appointees. We had even less than we have today, and today we have a very small number relative to the size of the agency. Had an even smaller number back in '92. So I was constrained to leave in January of '92, before the new President [William J. Clinton] was inaugurated, and left the agency at that point. Of course, it was interesting, because I came back eight years later, and the same Administrator, who had given me my—quote, unquote—"pink slip," I was now head of the transition from a new administration, obviously, in this case, Bush "41's" son, [President] George W. Bush, and Mr. Goldin was what we refer to as a holdover. He had very kindly agreed to stay on with the new administration until we found a successor, but the irony was not lost on either the Administrator or any of us that suddenly I was back.

He was very professional and very generous in welcoming me back to the agency. In fact, I recall at the very first senior staff meeting that I attended, that he chaired, when it came my turn to talk, I said to the staff, I said, "Now, if I can resume where I was rudely interrupted eight years ago," and people were very accepting, and it was a terrific acceptance back to the NASA family.

WRIGHT: Well, we hope to visit at length about the transition and, of course, the duties that you've had over this past year, at a future time. Before we end today, are there any other areas or any other thoughts that you would like to add about the commercialization era? One question I had wanted to ask you, and it might be a way to summarize -- when you originally started in the

early eighties, or really the late seventies, has the definition of commercialization changed in your mind compared to what you're seeing happen now?

STADD: Yes. On the one hand, I still feel strongly that space development ultimately will be driven as much by commercial entities, entrepreneurship, in the private sector as by the space agency. With my years of experience now, and I've been associated with this commercial space community for going on twenty-six years or so, twenty-seven years now, I have, I guess, I hope a more sophisticated sense that I think the government has an ever more important role to ensure that there is the appropriate policy and regulatory environment to foster a commercial involvement. In terms of commercialization, I still believe it's defined by the degree of risk and the degree of financial exposure that the commercial sector has in play, and to that extent, I felt that twenty-six, twenty-seven years ago. I feel it even more strongly today.

I do feel that there still continues to be a tendency for some private-sector players to refer to their efforts as commercialization when it, in fact, is really a government-supported activity by another name, in terms of either the degree of loan guarantee that they're seeking, or by the degree of government financing that they're seeking.

At the same time, I'm heartened that I think we're having more honest and more open discussions between industry and government as to what truly is commercial versus what, indeed, is a government-supported activity, and I think that what we're tending to evolve to for the moment is more of a hybrid in terms of government-industry interplay.

As I deliver these comments in the year 2003, this is not a particularly good marketplace today. We have in the launch industry far more capacity than demand warrants. We have, as I mentioned early in the interview, too few commercial launch actors that are in the market today,

and any market that is dominated by a few players, as today's launch market is, is one where I believe the American consumer, the marketplace, ultimately suffers, because you suffer from the lack of innovation and differentiation.

On the other hand, I'm heartened by the research investments that this agency is making in some of the cutting-edge areas of materials processing, life sciences, and other areas in propulsion, that I strongly believe are going to lead to a very hopeful future in the upcoming next several decades of the 21st century.

One of the reasons I've wanted to do this interview, and I look forward to continuing discussion, conversation, with you, is that we do have a new breed of entrepreneur that's coming into their own, and some of these people don't have the benefit, frankly, of the corporate knowledge, and I'm hoping that myself and others who have lived through the last couple of decades in commercial space can help pass on some of the lessons learned as they establish their own businesses.

However you define commercial space, I can tell you, based on my own experiences, that this is a very, very tough and a very challenging business. I can't emphasize enough that reducing theory to practice in commercial space is probably one of the most daunting challenges imaginable. At the same time, I do think that people such as G. Harry Stine, who talked about the third industrial revolution in a book that came out in the seventies^{*}; one of my mentors, Gerard K. O'Neill, who talked about human settlements in space, back in the seventies, as well, that I do believe that their visions ultimately will take form, but as with any of these visions, it will probably take a different form than they anticipated. But I do believe that the eighties and

* G. Harry Stine, *Third Industrial Revolution* (New York: Putnam, 1975)

the nineties were important to laying the policy and regulatory framework to ensure that those visions come to fruition during the coming decades.

We're still, frankly, working our way through a lot of the terms and conditions associated with commercial space. An example of that is the nongovernmental organization (NGO) that the agency has been developing for the Space Station. It has been interesting for people like myself to see that NGO, which has been developed and advocated by our Office of Biological and Physical Science, which is the primary agent for research on the International Space Station, it's been interesting for me to see a lot of the issues of pricing, definition of commercial space, intellectual property, the appropriate interaction and support from government surface, because in many ways they are echoes of what we dealt with back in the eighties and nineties in these different arenas that we've been talking about.

WRIGHT: It will be an exciting time to watch.

STADD: Very much so.

WRIGHT: Thank you for today's time, and we will set another time for sometime in the future.

STADD: I look forward to it, Rebecca. Thank you.

WRIGHT: Thank you.

[End of interview]