FOUR PATHS TO COMPUTER ANIMATION: ENTERTAINMENT, BROADCAST, EDUCATION, AND SCIENCE--WILL THEIR FUTURES CONVERGE?

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Panelists:

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NANCY ST. JOHN: I'd like to start this morning with a little exercise. Do you feel up to it? I know its tough when you have been partying for three nights in a row, but let's just try this.

I'd like all of those people who have had their work seen on any television program or in the media to put up their hand.That includes anyone from the commercial and broadcast fields as well as all you scientists.

Okay. How many of you have ever had your images published in a technical journal or in a technical paper of some kind? Hands up. How many of you have ever made slides for a talk using a computer? Hands up. Great. Now, how many of you have raised your hand more than once. I guess I can say that I have a lot of cross-over people here.

And what do I mean by that? Well, have you ever noticed how many of your scientific friends may just happen to play music or be really good artists? Or have you ever noticed how many of your artist friends actually like to build things or have an interest in the physical sciences. And have you ever noticed how the field of computer animation seems to attract a multi-disciplined and multi-talented eclectic group of people?

And yet, when we talk about computer animation, we talk about the evolution of computer graphics applications like scientific graphics, broadcast graphics, educational graphics, and business graphics. We talk about broadcast logos versus commercials versus entertainment and we have all these disciplines broken up into little subgroups.

We talk about how it was in the 60s, the 70s, and the 80s and wonder what it's going to be like in the 90s.. I guess that's what we're here to talk about today.

I think we should look at our history and realize that we have always had the same problems. In the 60's it was hidden line removal, the 70's were hidden surface removal and paint systems, in the 70's and 80's we were dealing with illumination models and today we face the problems of object motion and object creation and deformation.

One thing is for sure,we all have the same needs. We want things to be faster. We want things to be cheaper and we all want our tools to be flexible but robust enough to support complex sophisticated projects.

So as far as I'm concerned, we don't have a separation. We're all the same group and we're all interested in computer animation. And that's why I've invited these four speakers today because I think these gentlemen will speak to the question of: Will the various areas of computer animation converge? And when you look at the definition of "converge" you can think: Will their futures come together or unite in a common interest or focus?

The first speaker this morning is an electrical engineer or used to be one. Now he's in business and he has a computer animation production company nearing its first decade which I think is an amazing accomplishment. He's also a software writer and he's written a lot of the software for his company, Pacific Data Images. And he's won a lot of awards. He's an animator and he's produced well over 200 jobs. I'd like to introduce my first speaker, Carl Rosendahl, President of Pacific Data Images --

CARL ROSENDAHL: Thank you, Nancy. What I'm going to talk about this morning in my ten minutes is a little bit about where we've come from, the kind of work we're doing now, and where we're going.

I divide PDI's markets into three areas: broadcast, advertising and long format. I'm planning to talk about each one of these briefly and then discuss where I think it's all going.

The first area is broadcast. This is the work we do for networks, cable systems and TV stations and includes IDs, program opens, promos and news graphics. This use has perhaps the greatest constraints over what we can do. There is a very specific message that needs to get across in a very short amount of time. It has to be visually interesting since the viewer is going to see it over and over again for years -- it can't be something you are going to tire of quickly. It also has to carry a lot of information. A station promo is perhaps the biggest challenge. It's on the screen for about three seconds, and you have to be able to read what the show is, what date it's on and what station you get it from -- in three seconds. And that's the reason that so much of broadcast graphics has to be so clean and simple and crisp and fast.

The status of the broadcast industry right now is that it's a very limited growth industry. Basically, all the air time that can use computer graphics, is using computer graphics. About three or four years ago, it all started being replaced from being film graphics or other forms of animation or graphics. And right now, it's all computer animation. Basically, it's a turnover process. You know, new openings, new ideas. So it's limited growth. There basically is much business there being done as, I think, will ever be done.

Of the three markets that we're in, it's also the one with the lowest entry cost. For under $100,000 you can get a lot of equipment to do what needs to be done.

It's highly competitive and that's part of the reason it's such a low entry cost. And the quality is very variable -- depending on who your client is, how much money they have, you can really do some bad stuff and get away with it, get paid for it, and get on the air. Sad, but true.

Advertising uses. Basically, I see four primary things where computer graphics is being used in advertising. The first is logos and tags, second is product demos, third, character animation, and fourth, environments. These are basically all the options of the ways people ask us to use computer graphics to work in their commercial. And obviously, you can mix them together in all sorts of ways.

There're really two major constraints to dealing with the industry. The most important one, from my point of view, is that there are a lot of clients to please. A lot of the jobs that we've done, we've done in conjunction with other production companies. For example, the Crest commercial that you may have seen in the film show, if you went to it, was done with Charlex which is a production company in New York. So they were directing it. We had to please them and they had to please their clients at the ad agency which were four, five, six people. And then when they were happy, they had to please the people at Proctor and Gamble. It's a very long process to go up, to come back down, before you get the feedback you need to go on -- as opposed to the broadcast industry where there's usually one or two people you're dealing with who are in a decision-making position Also, with advertising, you're limited in the amount of screen time you have to about 30 seconds maximum.

The status of the advertising industry. Emerging from a slump. This is actually a little bit the wrong time to say it because the writer's strike is having a pretty devastating effect on a lot of the advertising. But in general, the attitude I see in talking to people from the advertising community is they're once again interested in using computer animation. Remember three or four years ago, there were all sorts of highly technical, computer animated commercials. The pendulum had of swung to high technology. There were a lot of vector graphics, and a lot of using computer graphics because it was computer graphics. It was used to make an image for the company that they understand technology and use it well.

Then the pendulum swung the other way, from high tech to high touch -- just people and feelings. The Hallmark Card commercials being perfect examples. Now it's swung to kind of the middle ground, I think, where people are using computer graphics not because it's high tech and it gives them that kind of an image, but because it helps them tell the story that they want to tell. And that's the reason that we want to use computer graphics.

There's a real strong interest now in using computer animation for doing characters and that's probably the most exciting thing about the advertising community to me today. It's a moderately competitive community, very price sensitive and there's a moderate entry cost for getting into it.

Next: long format. This kind of covers everything else. If it's over 30 seconds long, to me, it's a long time. And basically, the areas that we're looking at for applications of animation are television programs, motion pictures, music videos and things along those lines. The uses in long format are: character animation, environment, special effects. Any one of those can be used independently or together.

Constraints of long format: money, money, money and visual complexity. I've been working for the past year to year and a half to really try and get a lot of people in the television industry interested in using computer animation and really taking advantage of what we can do these days for them. The first question, every single time is: will it cost me less than what I'm doing now? Unfortunately, I have to say, "Well, no, but it'll be really different and really cool and people will love it." And they say, "Well, that doesn't matter because we're already losing money doing the production we do and we really don't want to lose more."

And then visual complexity. It's got to be something that's interesting, that's going to draw your eye to it. No one's going to pay us to fly letters around for a TV show. You've got to do characters. If you're doing characters, they have to be really interesting characters -- characters with a lot of emotion and feeling and just visual interest to them. If you're doing environments -- no one's going to pay you to do an empty room. You have to do a lot of stuff in it. If you're doing effects, you're competing with the real world, real special effects, so you better be able to do them better. And all that leads to visual complexity.

The status of the long format industry. I think this is a very significant time for all of us because this is the year, I feel, that we're crossing over the line and becoming economically viable for long format situations and I think that's due to a lot of reasons. First, computers are continuing to be faster and cheaper. We can now start to economically compute the kind of frames that we need to compute. Second, all of our tools are getting better and that just comes through a lot of experience in developing tools and developing better tools on top of those. And then, third, there's economies of scale. If you're doing 30 minutes, the expense doesn't just go up linearly. There's a lot of work that you can do up front to really save a lot of money there.

Parts of the industry are really excited about using computer animation. They can get a new look. They have a much higher quality and more control than the animation that they're getting by going overseas. There are also parts of the industry who are not excited. What can I say? They should be.

The most important thing about long format to me is that it's the beginning of the evolution of a new form of storytelling. We can do new types of characters and new types of stories that are only going to be possible for us to tell using this new technique. If you look at any medium for communicating, be it film, traditional animation, novels, painting, photography, whatever -- there's an evolution it goes through in creating it's own language, it's own form of communicating.

If you look at cinematography it went through three steps. The first one was what I would call "techno-marvel". You know, Edison creates this thing so you can project film and people look at it and they say, "Wow! This is amazing." And they go to the nickelodeons and they pay their nickel or their penny to watch a flip book of pictures. They just get blown away by it and it's amazing. So there's a stage that it goes through where: "Wow! That's wonderful! Isn't it incredible what technology can do?"

The next step it goes through is starting to emulate other forms of communication. So a lot of the first films, a lot of the stories that were told with film, were done by locking down a camera in the middle of a theater and letting a stage play go on it. The camera was a static observer of what was going on.

Then finally, they discovered, "Hey, we can move the camera. We can start it and stop it. We can do editing. We can do camera angles. We can do dramatic lighting." And a whole language for communicating with film evolved. And today's it's a very, very specific language and you can get books this thick on the language of film.

Traditional animation went through a very similar process. It started out as being techno-marvel. "I can bring drawings to life!" And people were amazed and thrilled. Then they started thinking, "We can actually entertain with it." They drew from other media. They drew from this whole language of film that existed. They drew from comics, which is where they all came from -- newspaper comics, comic strips and such -- and started using those. Then they went and started evolving their new language, and it's one that we're all looking at very hard today -- squash and stretch, timing -- all these sorts of things. There was now a new language for communicating with traditional animation.

So this is what we're going through. We've gone through techno-marvel -- "Wow! You can make pictures with computers. It's amazing." People would pay us to do that, that's where advertising was a few years ago. And now we're starting to draw from all these other mediums. We're drawing from graphics. We're drawing from cinematography. We're drawing from traditional animation. We're drawing from physics. We're pulling in and trying to experiment with all the languages for communication that are around us right now. We're still in that phase of using other mediums, the languages of other mediums, to learn how to communicate with this new one. Once we understand those, we can start pushing that in new directions.

I think over the next few years, we'll really see the beginning of this evolution of using computer graphics as a new form of communicating and a new way of telling stories. And that's what we're really interested in doing.

NANCY ST. JOHN: Thank you Carl. Our second speaker today is a mathematician and a jeweler. He was staff scientist at Livermore Laboratories for seven years and a specialist in fluid dynamics. He created the planet Jupiter for the film, "2010," and he was an animator, a technical director, a software writer, and a scientific producer -- all while he was at Digital Productions in L.A.

He was the co-creator, with myself, of the Scientific Visualization Program at the National Center for Supercomputing Applications at the University of Illinois as well as being a research scientist in graphics. And he's currently working as a visualization scientist at Stellar Computer. Craig Upson.

CRAIG UPSON: Good morning. I'm going to talk about visualization in the computational sciences. I thought I'd start with a few examples of some older images and then work my way up to the present. Just some rough examples of what the field's been doing in the last 10 to 20 years. What I actually did is I went to Bruce Brown, who's been in charge of the SIGGRAPH slide show for several years and I went through all his slides to see what older images he had.

This is an image that came from the University of Utah. My guess is probably mid-70s. And it's an early image, probably one of the earliest images of medical imaging, if you will, of a brain. It's barely recognizable as we look at different sides of it. It's several different contours of material inside a skull. And this is essentially the techniques that we use today for a lot of other images and things haven't really changed a whole lot. You know, the complexity has gone up, but in general, the methods we use haven't changed dramatically. You look at this skull compared to the ones we see now and there's a lot more complexity now, but we're still using the same basic techniques.

This is an image from the mid-80s. One that can be produced in real time from the medical imaging field. In volume imaging, we're getting more and more detail from the data that we're using. And in some cases, we're developing new techniques like volume imaging. But in many cases, we're using just the same old techniques.

This image is a fairly new one, but it certainly is something that could have been produced in the mid-70s, of a molecule. And as we look at the progression in the molecular sciences, computational chemistry, the ways of representing data really haven't changed a whole lot either.

This is from Paul Bash at Harvard. It's a ball and stick model with an isopotential surface, a contour surface of the potential field and other techniques, such as this from Mike Peak at Scripts, show more detail of a molecular surface. So in some sense, I think probably the molecular modeling field has progressed much more than other fields in the computational sciences in terms of visual representation forms.

This simple 2D contour map in black and white is how most computation fluid dynamics scientists represent their data today. It could have been done in the 60s and and is still the prevailing method of representing large simulations. This is from a 3-dimensional simulation and you get very little information from this one graph, but it none the less, gives you very specific information where you might want to look for more detail. But you're still getting discreet information. Other techniques are creating a contour surface and this is a fairly recent image that was done last year in NCSA at the University of Illinois. And you're getting different information now. You're getting all the information along a single thresholded surface of this 3-dimensional simulation. But it's the same technique that people at the University of Utah used in the mid-70s and another way of representing that is through volume rendering. This is the same simulation of that tornado, but a different way of looking at it.

If we go to the computational mechanics field, the most common way of representing anything still is by wire frame. This is a cylinder that's been dropped on a bar and you see the deformation in the center of the cylinder represented by the really dark areas. These areas are the different contours of the stress distribution on that cylinder. But this is a technique that was used in the 60s and still common today.

The same data set, but now shaded with flat shading is seen here. This is again, from Bruce Brown at WANG. This was created probably around 1980, maybe '81 and this is the common techniques that are used today. So in some sense, one conclusion is that we really haven't developed a whole lot of new techniques for scientific visualization in the last 20 years. And I'm going to try to address that issue in just a minute, but the first thing I'm going to talk about: what is scientific visualization.

It's really just a new name for a fairly well-established, but perhaps somewhat floundering field. Floundering, mainly because it really hasn't kept up with the demands that are being generated by computational scientists. Simulations are generating much more data as well. CT and MRI scans are producing layer 3D datasets. It's hard to deal with that kind of stuff. So we haven't really kept up with the demands in those fields. Let me define at least what I think this field is and the processes that a scientist goes through when he's trying to understand a phenomena that he's simulating and what the visualization process is throughout that regime.

These are essentially the steps that the scientist goes through when he simulates something. The first step is researching a method, you know, trying to figure out: "What is it I want to solve?" "Now that I've got the program made, I've built the simulation code that does this. Now I want to build a simulation -- set up all the parameters that govern the phenomena that I'm trying to represent." That's boundary conditions, building a mesh -- that kind of stuff. Then I want to pick my favorite super computer or mini supercomputer or whatever, and compute on it.

Once I'm done with that, well then, what do I do? I have to figure out what I just did and that usually takes a long time. That's the analysis step. And then, at least in the way that we do things -- we typically go out to some media, like film or video. So, in essence, a scientist will spend an awful lot of time going through this loop.

And the visualization process here is essentially this, of taking the output from the simulation, going through another loop: The analysis step is a loop. Deriving the quantities that are interesting to look at, making the translation from raw data to geometric primitives (things that can be rendered), making images of those things, playing those images back and then recording them on to some media or writing a paper. And so we spend all of our time going through this loop essentially. Most of our time, trying to understand what a simulation is doing is spent in this loop. So those are the basic steps. Now I'd like to talk about some trends that I see.

They fall into two different categories. One is cultural trends and the other one is technological trends. In the cultural trends, the first one is removing the Hollywood stimga, is that essentially, there's a problem in the computational sciences, that people tend to equate good graphics with bad science. People are worried that a scientist can get funding if he has a very slick presentation regardless of what the content of the science is. And I think that this really ...

The scientists that typically complain about this the most fall into two different categories. There are those scientists that don't have access to visualization tools that really don't have the ability to analyze what they're doing. And that's a big problem that we have to fix.

Or they fall into another category, and that is, that they're not really doing top flight research. The ones that are doing top quality work aren't worried about this issue. I think the basic question here is really the process of funding. How does an academic researcher get funding? That is, if the grant reviewer can't really distinguish mediocre science from fancy graphics, then it's not really the problem of the visual representation form. It's a problem in the funding mechanism. We should work on the funding process and work on educating grant reviewers and get back to science.

Second point is, I think we're going to see some demystification of visualization. If you look at it five years ago, this field wasn't esoteric, but now there seems to be some overtones of that and I think this really stems from two things. Admittedly, it's more complex now. We've got to deal with all this massive amount of data and very complex spatial and temporal data. But I think the mystique also stems a little bit from the fact that we now use specialists, graphics technologists that help the scientist do something and so the scientist says, "Well, this is a little bit more mystical than I thought it was." And I think that'll go away as soon as we get tools in the scientists' hands -- good tools.

Third one is, building visual vocabularies. Essentially, we have a hard time really explaining the graphics and the animations that we create. There really isn't any standard ways of representing various phenomena. So scientists spend a lot of time saying, "Well, what is that? I don't quite understand what I'm looking at." We don't really have a language for it. We don't have a vocabulary. We don't have a syntax. We have no grammar except the molecular modeling people have been able to do quite well in that regard. They have their own geometric primitives and a syntax, essentially, for communicating their images to each other. And I think that'll change as other fields come up to speed also -- computational fluid dynamics and structural mechanics, etc.

The last point on this slide is getting the scientist back in the saddle. By that, I mean what I hinted at in the prior point, is the moving away from using graphics people -- graphics technologists, you and me -- that is, that produce animations for scientists. We need to get the tools in the scientists' own hands.

A good analogy, I think is how useful would word processors be if only specialists could use them? They really wouldn't be that very useful at all. So we need to get some tools back in the end users' hands.

Now I want to talk a little bit about technological trends. There are four trends that I see that will be emerging probably in the next three to five years, or two to five years. One is common tool kits. That is, you know, shareable software tools that are built on hardware and software standards that scientists can use in one environment and find in another environment also. Currently if a scientist goes from one institution to the next, he ends up relearning how to use all this stuff or rewriting it and that's a big waste of time.

And I think that this is really going to be fixed. The reason this really hasn't been fixed before is because there really wasn't an economic opportunity and I think the economic opportunity now lies with hardware vendors actually, rather than software vendors, because hardware vendors have to produce this stuff to compete. When the first Cray 1S came out, it was shipped without a compiler. You can't do that now. You can't sell machines without compilers. You can't sell the machines without operating systems. And now, you can't sell machines without a lot of other stuff, too: soon that list will include visualiztion environments.

Visualization environments. I think that we'll move toward large integrated suites of common tools. Suites which minimize the headaches that you go through in turning data into imagery. The whole process of, you know, data management, data manipulation and image creation into coherent suites of tools. And those, I'm sure, you'll see in the next year or two.

Soon we'll be more interested in modeling rather than rendering. Making that translation from data to geometric primitives is probably the next hot of research rather than different illumination techniques. How do we build geometric filters that tie surfaces and all that kind of stuff. And I think most of the rendering is going to be done in hardware. And that sort of reduces the glitz, too, because hardware doesn't have all the capabilities that software does.

And the last point is: visual co-processing. And by that, I mean essentially something that John von Neuman thought of in the mid-1940s: His ideal method of interacting with the computer by what he called "oscilloscopic graphing" or making images. Essentially John von Neuman wanted was something like an interactive, numerical ... a natural phenomena simulator, just like we have flight simulators. And the question is: why isn't this the way of dealing with simulations now? It really hasn't happened and I think the traditional excuse has been that hardware just hasn't been fast enough. That's changing. As Carl said, there's a big change in economics in terms of machines and so now we're getting machines that have decent graphic speed, bandwidth, high compute performance, etc. So now, the question is: well, why haven't people been working on the software that's needed to really interact with those machines and anticipate where we're going. It's tough to do.

So that's essentially my talk and the question that I'd like to pose to you is: Can you replace every reference I've made to scientists, with animators? They essentially want the same types of things. Animators want to use the same software that they've used before. They're looking for environments that are flexible, they want interactivity, and they are moving more and more into simulation to bring our realistic dynamics. And so Carl has to teach them how to use this new software and it's the same problem, really. I really don't see a whole of lot of difference between the trends that we see in the computational sciences and in the entertainment field. Thank you.

NANCY ST. JOHN: Thank you Craig. Our third speaker today has degrees in both architecture and environmental design. He has written computer graphic systems for structural and architectural design. He worked for 6 years for Robert Abel and Associates in Los Angeles as a technical director, a software writer, a director and eventually as vice president for research and development. And now he's currently one of the co-founders and vice president at Wavefront Technologies. Mr. Bill Kovacs.

BILL KOVACS: Thank you. I'm glad to be here. My focus and where I'm coming from, I think is hopefully representing the people building tools, selling off the shelf products be they hardware or software, to solve some of the problems that these gentlemen have been talking about. And so I'd like to show you some things we've been doing and talk about some main themes -- those themes being visual problems, access to technology and ease of use. So I guess the question I'd pose here is: what's wrong with this slide?

Well, we did this, I guess for a Christmas card last year. We're very proud of it and you can kind of crawl in there to the frame and look at all the reflections going on, but as the company's been evolving very rapidly over the last year, the real thing that's wrong with this picture is that it doesn't really solve any visual problem and our particular industry is evolving, I feel, from a point where ... and this touches on themes that have been mentioned before, from how do we make wonderful, pretty pictures to, how do we plug that picture-making capability into solving ... or using the tool to solve visual problems.

And of course, it's the degree to which those problems are solved that drive the size of the animation marketplace. In that vein, is a project we've been working on with Ford and they have a classic problem. They're building cars and as you may know, they still build them with clay models. And they take some several months to build them. And once they build them, they cover them with mylar, then they put them in this room. This is the Ford room.

And so they have a sort of standard environment with lighting on the top and the same curtains and they look at them in black and white for the same reason that Campbell's Soup tasters taste the soup with red lights up on top, so they're not influenced by the color. They turn these around and make decisions and then go back and do it all again. And the problem of course, is that just prolongs the cycle of getting the product to market. The latest buzz word around Detroit, is "time to market". Everybody in Detroit is scrambling, realizing that the Japanese have cut about two years off of it. And so there's a very real problem here that's being addressed and visual systems are just getting to the point where they can touch on it.

I brought a video that shows this in motion. We went through a number of studies with this, comparing the real thing to the simulated object. And it came fairly close, but still, as you'll see from the side-by-side that we have a way to go. There you can see the side-by-side model on the left, which is actually two models and the simulation on the right.

Of course some of the inaccuracies are based on the fact that we didn't know enough about the room to be able to model it specifically. And you can see that on the computer, when it's seen up close, it moves around, does have some small artifacts that can be distracting. But it comes real close. Even at that, it's just on the threshold of being good enough to really solve the problem. I mean, this is a $10 million-dollar decision they're trying to make here on the quality of the design and they're not going to screw around. If there's any chance that this picture is not accurate, they're not going to take that chance. They're not going to use the technology. They're going to stay with building models. And that's of course, what most of them are doing. I don't think there's really a auto company that's set up to really employ the technology directly. They're all experimenting.

So these pictures that I'll show you here are just a few more examples. We're going from just pretty pictures to products in environments, looking at the effect of the products on the environments. A significant amount of complexity, of course, because you know, real environments have this annoying problem of having lots of detail in them. And people who were used to very simple graphics for explaining projects, are now getting into a lot of texture mapping and shadow casting. You can see that this satellite dish has got some shadows and the solar panels are done quite accurately.

And once again, the ante keeps going up in forms of what it takes to do a good presentation. Again, an aircraft photograph. High detail. A lot of texture mapping to get realistic detail. So I'm going to go very quickly through a little bit of history just to give you some perspective. I'm going to talk a little bit now about hardware and cost. And I just wanted to briefly put some of that in perspective.

The early 60s of course is when it started, certainly research. Certainly, the costs were anywhere from exhorbitant to unavailable. In the 70s, people were starting to talk about how images could really imitate reality, increase reality -- CAD systems proliferated. Motion was possible. People were starting to put matrix multipliers into hardware and in the late 70s, the cost started to drop. Dec came out with the Vax. People were starting to talk about image quality and I remember listening to the first paper on anti-aliasing and, for some reason, it just sounded ... I thought for a moment, it was really kind of going overboard actually, to worry about the value of these pixels at the edges of the polygons.

It's obviously now just the commonest feature in off-the-shelf software, but that's an indicator of the way the field's progressing. And of course, in the early 1970s, people started to use these computers. What comes to mind are all the production houses around the country writing their own code, doing this stuff. This is not to say that they were making money on it, but they were having a lot of fun and they all had fun until the money ran out.

So in the 80s, we saw the combination of Raster and Vector -- one box does it all, with video output. Our company couldn't have really existed without these kinds of products because this is obviously where Wavefront starts to plug in. The dynamics become more and more real and again, these were available off the shelf.

Now, as you walk around the floor, you're seeing super high quality. Everybody's trying to push the top down. Some people are telling me that radiocity is the latest thing. Ray tracing, all sorts of alternate rendering schemes, but lots of realism, lots of dynamics, hardware available to do that. And although the last statement on this slide is kind of a market hype comment, it really is the case that there are databases out there that are waiting to be visualized and that's the goal of a lot of this.

What people really have is all sorts of levels of realism and the cost goes up with each level of realism. These are pictures that represent the sample points on that graph. But what they really want to do is make an image that can be anywhere on that graph -- lots of inexpensive pictures, or very few, very fancy pictures and the ability to go anywhere in between. And that really kind of defines the ideal product.

This is a photograph from a year back. It's still fairly current, but this is an indicator of the number of boxes you might have to plug together to do computer animation, especially if you were trying to do high quality. And this has to change, obviously. It's changing. People are compacting some of these video processes back into the workstations and of course, that just makes it easier to get your hands on one piece of hardware that solves the problem.

Tomorrow? More speed certainly. Networks are obviously here to stay and a defense to sort of breaking up the work into pieces. Everybody seems to have rendering. It's obvious. The real question is how do you get at it and how do you make those beautiful pictures. And I think that touches on the final issue, which is ease of use. My favorite ... this doesn't necessarily look like a lead on slide for ease of use, but it's done by one of our clients who is a sculptor who bought this system as kind of a personal computer, believe it or not. And two days into his training course, he came into my office and he said, "Gee, you know, I've been thinking about this and I don't know if I can do this stuff. There's numbers here and I have to ... what's an operating system, really?" And questions like that. And I said, "Well, you know, stick it out for a week and, you know, if worse comes to worse, perhaps you can get an apprentice and you can focus more on the sculpture and he can focus more on the technology." But lo and behold, he sort of got into it more and more and finally developed a feel for it and now I'm seeing his work on covers of computer magazines and such. It's really amazing to see.

I'd like to make the point that the real modern architecture as far as ease of use is concerned, involves an interface that can change. If you go into a telephone store and you look at all the telephones -- the Mickey Mouse phone the Trimline, all the way down to the one that imitates the first phone, you know, done in wood -- you know that they all have the same reliable digital and they'll all plug into the network and get the work done. But obviously, people buy those different styles.

And computer software will evolve to that point where the way the product appears has maybe even more to do with its appeal and its attractiveness than the actual guts of what's behind the screen. So I feel that's a significant future trend. And also what we're seeing that I think is encouraging is that in terms of offering people these kinds of software and hardware products, the companies that offer them are maturing.

In our particular case, we're now able to offer ... you're not only seeing primary software, but other companies writing software to aid and augment the software of the more mainstream companies. So as these companies are able to not only design the product, but provide all the peripheral support and training, to actually bring that to bear on a problem, will be progressing a lot more quickly. So thank you very much.

NANCY ST. JOHN: Thanks Bill. Our last speaker is an artist and a musician. He's produced more frames of animation then Digital Productions, Robert Abel, and Cranston Csuri combined. He's produced over eight hours of computer animation just for his Mechanical Universe series. He holds degrees in physics,and in computer science.

His participation in SIGGRAPH conferences includes 15 tutorials, 9 papers and many panels. He received the first computer graphic achievement award in1983 -- the highest honor that is bestowed by SIGGRAPH and in the same year, he received the NASA Exceptional Service Medal for his contributions to science and to the space effort.

He's currently at Cal Tech, attempting to produce educational videos for high school mathematics and he's finally cutting his roots from JPL in October -- Dr. Jim Blinn.

JIM BLINN: We're supposed to be talking about four different aspects of uses of computer animation and whether they're going to merge together into one happy family in the future. And I'm going to basically say, Gee, I sure hope not -- primarily because the other three aspects of computer animation are evil and wicked and the educational aspect is good and virtuous. And I hope to make that point here.

First of all, let's contrast education with advertisement and broadcast. The big problem I have with advertising and largely broadcast-type thing is, they're primarily in the business of selling lies. What this means is: they're trying to say that their product is inherently better and more worthwhile and more exciting than the competitors' product and you should not even consider buying the competitor's product -- their particular car is great and the other ones are terrible and horrible and of course, actually, you realize that's never true. Cars are basically have some minor differences between them, but they're kind of all the same thing. But an advertising thing is not supposed to show you that, it's supposed to show you why this one thing is so tremendous and wonderful. And when the advertising people start getting into the science and education business, I worry to some extent. As was pointed out earlier, to what extent people's scientific theories perhaps are going to believed and given validity more on the basis of how good an advertising agency they have and how good a flashy video they have, rather than on the basis of evidence or the believability of the theory itself. It's something we have to watch out for.

Let's compare education, say, to entertainment. What I've been doing in the past -- educational programs -- has been really fairly simple graphics, which is the primary reason I've been able to get away with generating so much of it. If you make simple pictures, you can make more of them than complex ones. I find the big difference between education and entertainment is that what I'm trying to do is to come up with the simplest possible picture that gets across the idea. Whereas, in entertainment, usually they try to come up with the most complex possible picture to get across the idea -- keep people entertained. You hear the word "We want to dazzle the viewer," and so forth. And I'm surprised that people use the term "dazzle" because that's a perjurative term. It comes from the same word as"daze." You're numbing people's senses.

You're making them tune out in some fashion and I'm trying to open people's minds rather than to dazzle them and blaze their eyes.

Let's compare education versus scientific animation. This is where one would initially think that there was the most in common. And first of all, I want to define how I distinguish between the two. The education game is primarily a documentary thing. It's taking some ideas that are already well-known or well-accepted and presenting them to people. The people producing it already understand the thing and are just trying to share the information with someone else. In scientific research animation, you're experimenting with ideas yourself. The person producing it doesn't really know. They've got a theory that they're working on. They're not sure if it's right or not. They want to see what the results of the theory are and so when they see the animation, it's news to them. A lot of the time it just shows errors in a theory.

Now, there's a move afoot to bring flashier animation to the science research sort of thing and I'm not entirely sure that's a good idea because when you're experimenting with ideas and you're not sure if it's true or not, you don't want to lend too much credence to it beyond what it's worth. I mean, this stuff has a tremendous longevity. You make this really neat color computer animation and the scientist is playing with his theory and discovers maybe there's something wrong with it or changes their mind or something as a result of looking at it. But the animation is still around and you know, five years later, some television production or some magazine wants it a nifty picture to put in there and they'll scarf it up and put it in. And these are theories that aren't even any more held even by the proponents, originally. So there's a case for saying that: if you're not really sure of whether your theory is correct or not, you should make the thing kind of crude and sketchy-looking so that people who look at it understand the fact that this is all just theory and not necessarily what is considered truth.

I've done a little bit of this in some of the educational animation on a slightly different tack, with the difference between an animation that's driven by numerical simulation showing the dynamics correctly versus animation that's diagramatic and is supposed to show the big picture rather than the details. And the diagramatic animation should make the lines kind of wiggly and sketchy, like it was hand-drawn, rather than mathematically, perfectly straight because that implies computer simulation. So anyway, I just wanted to wrap up and say that computer graphics has a lot of power to communicate and we just need to think a whole lot about using this power wisely and making sure that what we say is what we really want people to go away with. Thank you.

NANCY ST. JOHN: Thank you Jim.We have finished exactly on time and we'd love to have lots of questions. If we could have the lights up in the house so that we can see who we're talking to. And would you please come up to one of the microphones on the floor , give us your name and affiliation please.

(Did not give name) : In Moby Dick, Herman Melville said that "the soul is kind of a fifth wheel." And I was wondering if any of you thought that perhaps art is kind of a fifth path to computer animation. And in response to those of you who see art as a subset of entertainment, let me just say that I think it's the opposite.

NANCY ST. JOHN: You mean, why don't we have an artist up here? We should have an artist up here. I'm sorry. We're only allowed four people.We blame it on SIGGRAPH. I think we have a good representation of artists. Perhaps not in the traditional sense, but I can't imagine you telling me that some of these gentlemen aren't also artists. And I think that was the whole point of the talk -- that we don't give people labels. We don't say, "This is a scientist who can't possible do art and this is a person who writes software who can't possibly be a scientist." I think that was the idea to kind of eliminate the labels.

BILL KOVACS: And something that's interesting about the art world is that it's obviously centuries old and there have been so many different mediums that also exist -- sculpture, painting, drawing. And the computer is just one recent one. In some ways I see it as not having quite the same impact as it's having on some of these other disciplines. It certainly has its contribution, but it also has its ability to distract and all of that. It just hasn't seem to make quite the in-roads as in other areas.

CARL ROSENDAHL: I think it will. The view that I would have is that it's an evolutionary process. As I said in the talk, the first stage you'd have to get through is techno-marvel. Film wasn't an art form for a long time. Animation wasn't an art form for a long time. Photography wasn't. Go down the list. You have to experiment with it and turn it into one and make it accessible to people who can start using it and make it usable to people. From our standpoint, I'd love it if we could sit around and make whatever kinds of films and animation that we wanted to make without people telling us what to do. But there's some economic considerations involved. And if you want to have the tools available, the high-end tools to really experiment and start pushing what you can do there's a trade-off, and you have to have clients and you have to have paying customers.

We try to do art. We try to do things that express our own feelings, our own interests, without the demands of clients behind us. We give our animators time to work on that stuff. We had a piece in the film show that was non-commercial. We had some things in the art show.

I think it's a valid point. I think there should be more artists, but I think it will happen. I think that this is going to get in the hands of people who can use it and really do some phenomenal things with it.

: I think that we're basically lazy people in that we all essentially do try to solve the easy problems first. And I think it's a lot easier to get tools, you know, technical tools in a technical person's hands than it is to build tools that are designed for artists. That'll come, but we're having a hard time getting the right easy-to-use tools in the scientists' hands or in the technologists' hands.

JIM BLINN: One thing I'd say that's kind of opposite of what I said before and that is, a good aspect of a lot of the commercial stuff that's going on is the economies of scale. Artists typically don't have a lot of money and if it was only artists who wanted to do videotape editing, it would be incredibly expensive for them because it would all have to be technologically designed for them. Whereas, since there's lots of sitcoms and battle of the network stars and stuff like that, that supports a video production industry and allows them to have big facilities that artists and other people can rent for a lot less than had it been built only for them, maybe it's a good idea there's all this stuff around.

SCOTT KIM: Information Appliance. I often get the feeling that a large part of the industry are artists figuring out a way to also make money while their getting access to computers. I wanted to ask each one of you ... if you want to be in any of these areas, it has to be something that's meaningful to you if you're going to enjoy it. I want to ask each of you, why this work is meaningful to you, personally and how you chose that path you're on.

JIM BLINN: It's meaningful to me because it makes me feel virtuous. I feel very fortunate in the sense that I've been one of the people in the business who's been lucky enough to at least so far, get funding to do stuff that I really wanted to do that has what I consider more long-term meaning.

I have a lot of respect for people who work in animation production houses because you know, when I work day and night for 6 weeks and generate an animation, it portrays how the theory of relatively works, how the universe is structured. And when a lot of people from production companies work day and night for 6 weeks and tear their hair out and go crazy, they come up with a tin can commercial.

That's true, actually. And it has a lot to do with why I'm not working in that industry anymore. I think even when I was working in that particular genre, I think my focus and interest was on tool building. What's interesting to me is that a lot of the basic things that you see on the floor are not truly new in any fundamental, algorithmic way. What distinguishes all these programs and different software tools is just the clever application of known techniques to make fundamental thing more easy to use. It's just like a recipe...everybodyhas the same ingredients, but you're applying them in different quantities and they could have radically different degrees of success depending on your combination of the essential parts. So that's what's challenging to me a present.

CRAIG UPSON: Well, let's see. I guess if Jim Blinn is in this because it's virtuous, I guess I'm in it because I'm curious about how do we really understand what goes on in nature; what motivates scientists. And I think I just sort of fell into the field probably like most people have -- essentially, when I was going to school, there weren't any classes in computer animation or computer graphics.

And when I was working doing computational fluid dynamics, you finally realize that you can't really understand what you've done. You have no idea. You know how to solve the equations, but you really don't know: did I solve them correctly? And so you just sort of ... I just sort of go wander off into one direction and think--how do I see what I've done? And then I got captivated by that. And that's where I am now. But it's mainly just out of curiosity, I think.

CARL ROSENDAHL: My attitude was: I figure I'm a nice guy and here's an opportunity where I can be really evil and get away with it.

Actually, I got into it out of techno-lust and techno-marvel -- being someone who is really interested in film-making and just "Wow, you can do pictures with computers," but having a degree in electrical engineering and wanting to be in the TV industry for whatever poison I got when I lived in Los Angeles growing up. It was the right combination of being able to use the background I had to pursue the interests I had.

That's changed a lot for me in the past few years. The techno-marvel phase has kind of worn off. It used to be I'd make a picture back when I was animating and sit and be able to stare at it for an hour and just be amazed. Now the things that are exciting and amazing are starting to use it to tell stories, to communicate and experiment around and see what kind of new and different things we can do. So I've kind of changed my reason for being here and I have to tell you, this industry to me is more exciting today than it ever was before. It seems like there're more opportunities now because of all the different applications that are starting to be able to use it. And I just find that really interesting and stimulating.

NANCY ST. JOHN: Well, I'd like the opportunity to answer that question because I'm really proud being the producer of Hawaiian Punch -- that we made those tin cans. (APPLAUSE) Thanks to Tim McGovern and all the other people. And I think the reason why I like being in computer animation is because of the act of creation.

I come from the film industry and you basically point a camera at a scene and you record it and of course you can do some wonderful things artistically, with the lighting and the way you dress that scene. But there's something really magical, in a sense, about creating something with the computer and starting off with a very small kernel of an idea and have it develop into a board which then develops into all these objects which then get colored and lit.

And then we move them around and then by the time we're finished eight weeks later, there's this whole thing that has come together which wasn't there before. And if we hadn't put it there, it probably would never get there because it's not a piece of science. It's not a piece of math.

It's not something that we can take from the earth and say, well, this is something that we've learned from where we live. It's something that just starts as an idea. And I think that's what the essence of computer graphics is all about -- it's the fact that we can just take a kernel of an idea and create something and put it on a film or videotape and show other people. So I'm proud of it. The hell with Jim Blinn (APPLAUSE)

BOB HENDRICKS: I'm from the John Hopkins Applied Physics Lab. First, I wanted to make a comment. This occurred to me when someone was mentioning about art. I think that the convergence or commonality, at least between art and science -- we have a long history of that, even Gray's Anatomy -- the whole idea of art and science. They have something in common. At their best, they're supposed to be trying to convey truth. And they've always been combined or interdependent in some ways.

I just want to also say that and ask for a discussion about this -- it seems to me that in the area of computer graphics, what I'm noticing as converging, is not so much the applications as the hardware. I go down through the exhibition, I watch the show. I see something done for broadcast or I see something done for science. And they say, "We made this with a Wavefront on a Silicon Graphics"

And you go to someplace else and they say, "We did this with a Wavefront on Silicon Graphics." Or, I'm not trying to focus on any particular piece of hardware, but it seems like the same piece of equipment is doing all the different types of work. Could you comment on that?

BILL KOVACS: I guess it touches me more directly than others. No, I don't ... I think I have just the opposite opinion of it in the sense that when I cruise the show these days, they look more and more like toasters everyday. You know what I mean? They are looking alike and they're getting into the product, into the stage of products where everybody has a lot of the same features and you get into the kind of advertising mode that Jim was talking about. You know, we have more Mps. We have more flops. We can do more polys. Hey, we have radiocity. So I think there is a lot more diversity that expands the market. It gives people choices. And I think there's a lot of diversity out there in software. There's a lot of new software being shown here, both by established companies and companies that just poked up and so I think there's a lot of diversity there, too.

JEFF YOST: From the National Center for Supercomputing Applications. Yeah, I have a question. I guess mainly for Jim Blinn. I think using computer graphics to make educational films is a really exciting application, but I personally don't know of anybody outside of you that's doing it. I wonder if you see the field growing and where the funding is going to come from.

JIM BLINN: I wish I knew.

NANCY ST. JOHN: An excellent question.

JIM BLINN: I've done a little bit of reading in the history of animation in general, and I found some interesting things. Around 1923, Max Fleischer Studios did an animated film about the theory of relativity and when they finished, they discovered that nobody wanted to buy it. It basically lost money. And in the 50s, the Bell Telephone funded a series of science programs. And they hired an animation company in Hollywood to do little animated characters illustrating the science and the company went out of business because they didn't get enough money to pay for their expenses.

So that the whole thing of education is sort of a grim history. Basically, what I'm doing is sort of riding on the back of the industry in terms of everything getting cheaper and moving what I do to PC clones and small scale computers -- which is really adequate for what I need to do.

We are currently looking for funding at this point and we've gotten a lot of suggestions from people here. Hopefully, some day, people will support it, but it's always the case -- you know, the tax money and the school boards never have enough money to hire teachers at a reasonable salary and so forth.

I can say that because both my parents are school teachers and we always had this problem, which is kind of puzzling because this is, you know, education. It separates you from the muck. It's what makes it possible for you to go out and great things later on. And you'd think that it would be more supported than it is. From what I've seen, it's something that you only do because you think it's worthwhile, not because you're going to make any money out of it.

CRAIG UPSON: I see a lot of people trying to expose themselves to the medium and it's still an expensive medium as Jim says. And the very fact that you have to get funding, means that there's this chunk of resource you need that you can't scrape together personally in order to do sufficient quality of work to disseminate it to people.

BILL KOVACS: And I think that's just a function of the cost of the tools. Unfortunately, most of us up here are trying to do sort of a professional quality product and that isn't available on a personal basis, but as soon as it gets to a point where you really don't have to scrape that much for the funding, then it gets more like a more accessible medium.

DAVE FROSS: My name is Dave Fross from Farleigh Dickinson. I'd kind of like to turn the question around and ask you -- I wonder if we are past the point of our sort of maximum convergence and if we're diverging onthese various areas. Basically, my thought is that you people and the people that you might represent, so to speak, have used common technologies, papers from this conference and so forth, to build certain things. And now, it seems you're diverging in terms of getting applications and being more specific.

JIM BLINN: My interpretation of the question is: why should we converge now that we've gotten the basic technology there are many diverse paths to enlightenment and we shouldn't necessarily all want to look alike, and at least I would agree with that. Once the medium is there, then everybody's imagination comes up with different sorts of uses of it.

CRAIG UPSON: Well, I think there's a lot of power in two different fields learning from each other's mistakes and success stories. And I think that's why I'm interested in the convergence. I think your opinion was: well, maybe they've already converged and now they're diverging and I don't think that's true at all. I don't.

NANCY ST. JOHN: I don't know. I think I'm agree with him. I'm an example of a person who went from commercial production to the scientific field which turn out to be a huge mistake for me, but it was really a very interesting convergence because the information that was swapped during that two-year period, helped me a lot and I think helped the people I dealt with a little bit. I'm definitely much richer for the experience and now taking off in a different angle and I think the people I dealt with there are doing the same thing again, from their own perspective. So I think I might agree with him.

DAVID BARTH : Carleton University, Ottawa, Canada. Something I've always been interested in is real time animation to be used for education and science. For example, may be a real time mathematics lab where you can put in an equation -- let's say a quadratic equation -- and in real time, change the parameters of the equation and see the graph change, rotate it in three dimensions and see what it looks like. In terms of physics, putting together pieces of metal and so forth in a simulated world, getting an animation going and then asking for various forces at various points to see what the forces are. And maybe even for entertainment. Supposing you for instance, go to a museum and you have an exhibit that has some little characters -- let's say, dinosaurs, that you can control interactively in real time, and have various people sort of tackling each other with dinosaurs. What do you see as the future for real time animation for science in education?

NANCY ST. JOHN: Well, everybody should have an answer for this one, I think. You want to start Craig?

CRAIG UPSON: Sure. You know, as I said in my talk, I think that the big reason that people haven't been able to do real time -- at least their excuse has been that hardware speeds haven't been high enough and that's probably a cop-out to say now because hardware speeds are there for a reasonable size to medium-size problems that you want to solve.

Now it's a question of just making the tools useable for that. How do you really interact real time? The hardware will compute it. For at least medium-scale simulations, the hardware will compute it in real time. So now it becomes a question of: what do you really want to see? How do we interact with it and that really hasn't been solved yet. There are people working on it.

What is real time? In the 70s, the E&S boxes were real time for what they did and still are. And now, we get better and better capabilities at least in terms of rendering power and processing speeds that we can accomplish more and more in real time. It will never be fast enough. Whatever you want to compute now, it's still going to be 1/10th of what you can get in hardware and whatever you want to do in 10 years, hardware will be 10 times, 100 times faster, but still not going to be as fast as you want.

JIM BLINN: I had one interesting interpretation of the term "real time" at JPL during the voyager encounter. The scientists are looking at and analyzing the photographs and want some sort of image processing done. Their notion of real time is "overnight." That is to say, they look at something and it happens in time for the press conference the next day as opposed to having you take it back to their laboratory and study on it for 6 months.

So you just have to pick the right people, have the right definition of "real time" and you're in great shape, but in general, real time simulations are wonderful. I think they're neat and everybody should have them and, you know, there are a lot of things out there that do that already.

BILL KOVACS: I think what you're talking about is increasing the activity speed in general -- and I know that a lot of people in our little market niche are always trying to do that. I mean, we've been in business for four years and we're only now just releasing a product where you have full control over your colors and can place it in a button, get a scene in a few seconds, modify the scene, modify the lights, quickly review. And again, that's one of the things that contributes to ease of use, so we're going to see much of it I think, by the various software manufacturers as the hardware will support.

CARL ROSENDAHL: I have a question. Actually, Jim, I was thinking about your comments and stuff and I think ... I'm a real fan of yours and I think that everyone at

SIGGRAPH is an enormous fan of yours. The interesting thing to me is I think that you're a salesman and you're trying to sell education and you're doing a damn good job at it.

The reason I love to watch your films is not because I think I'm learning something I didn't know before and being refreshed for something I learned before, but I find them really entertaining and I enjoy watching them. I think that, yes, visually, they're simple and you're communicating very clearly, but there is a real beauty in the way you have graphically shown what you did.

You're not using just white lines on black. I think your use of color, drop shadows, nice letter forms is wonderful and I think that what you've done is taken the best of all the world's -- the best of entertainment, the best of graphic design -- and used it for an educational purpose, and I think you're doing a great job at it. But I think that in doing that, what you're able to do is sell education much more.

I'd be interested in seeing the Fleischer film to see, you know, maybe it's just not visually entertaining. And I think from my standpoint, if I were making an educational film -- which I would love to do -- I'd want it to be visually interesting. I'd want it to be entertaining and something that's going to cut through all that dazzle and clutter, to be something that people are going to want to watch.

JIM BLINN: I take it all back. I now see the error of my ways. I really think that advertising is a great idea and entertainment is what we should all do and we should make even vague science theories be as dazzling as possible. Actually, in fact, I got a copy of the Fleischer movie and it's incredibly boring to me. But you've got to have crude things before you can have sophisticated things. It helped advance the technology to some extent. I'm sure.

STEVE ROOK: National Optical Astronomy Observatories. To me, the pursuit of science is both entertaining and educational and for instance, I would love to be able to take some of Jim Blinn's planetary animations and put on a 3-D, head-mounted display and fly through it in real time. This obviously, will take some time to happen, but don't you think that we can raise the level of quality of entertainment by bringing high quality scientific and educational things like that to the public?

JIM BLINN: It depends on what you mean by entertainment. I mean, I used to be offended when a lot of things in entertainment films happened. Like a computer was represented as sort of talking English to the user and I'd think, "That's silly. They can't do that. That's not how you really talk to a computer."

But really, the main purpose of entertainment is telling a story. It's not teaching you how computers work and if they actually had a computer within a movie displaying OS 360 job control language, the audience wouldn't really get the story very much. So it's the same sort of thing, as you know, you see a movie about ancient Rome and they're all speaking English -- should you be offended at that? They didn't speak English back then. But you know, they'd have to translate it into terms that the main audience can see.

What was I going to say? One other interesting ... put on the head-mounted display and fly around the planets, which is at first might sound like a neat idea, but one of things that I've sort attempted to portray in the films - which is rarely done in entertainment - is the fact that if we had a head-mounted display in this room and we put a model of Jupiter in the center and the moons and so forth, around there, it might not look nearly as impressive as you'd think because these things, relatively speaking, are very small and very far apart. So it's like you'd have a BB in the middle in the center of the room and a little dust mote out here and so forth. For example, if you're close enough to one of the moons of any of the planets where it would show up as a disk, you're necessarily so far away from any of the others, it would just show up as a dot. There aren't any views where you see two moons show up as disks in the sky. Of course, that doesn't look neat, so entertainment people put several moons in the sky.

So entertainment is for a very different purpose than education and sometimes if you try to cram them all in the same criteria, neither one of them might work.

NANCY ST. JOHN: It seems to me that real time may be exactly one of those merge points for all of us because right now, Carl and I working on a project with Jim Henson and we're doing a real time muppet that gets matted into some live action that's being done on a stage. It's not very educational, but it's kind of fun. And what's happening is, finally the machines are getting fast enough and the software's getting fast enough and we're getting smart enough and everything's kind of meeting at one point so that we can do this sort of thing in real time. Computer animation is not good at doing animation, and now we're able to take the skills of these very talented puppeteers who understand how these things should move and understand how to create emotion in a character.

And we're able to just record that in real time as well as combine it with the live action as it is taking place and the puppeteer can automatically see what he's doing and how he's puppet is interacting with the other characters. And so what I'm saying is that we're finally being able to create what we want to do in real time.

And I think for the scientists, real time is being able to explore within their data in real time. They want to watch their simulation going by. The want to stop it. They want to re-run it. They want to look at it. They want a close-up on it. They want to be able to interact with the thing that they're working with.

And I think that's kind of what drives all of us. We'd like to have a much better response time and once the software and the hardware and the people are all smart enough all in one point in time, I think maybe that might be a merge point for us. And when do we see that? Maybe in the early 90s, from what I hear. Right? What do you guys think?

JIM BLINN: It sounds good. We seem to be leading to the impression that real time is the goal

NANCY ST. JOHN: That's not what I meant. I'm just saying, it's kind of nice and handy, but it's not the goal.

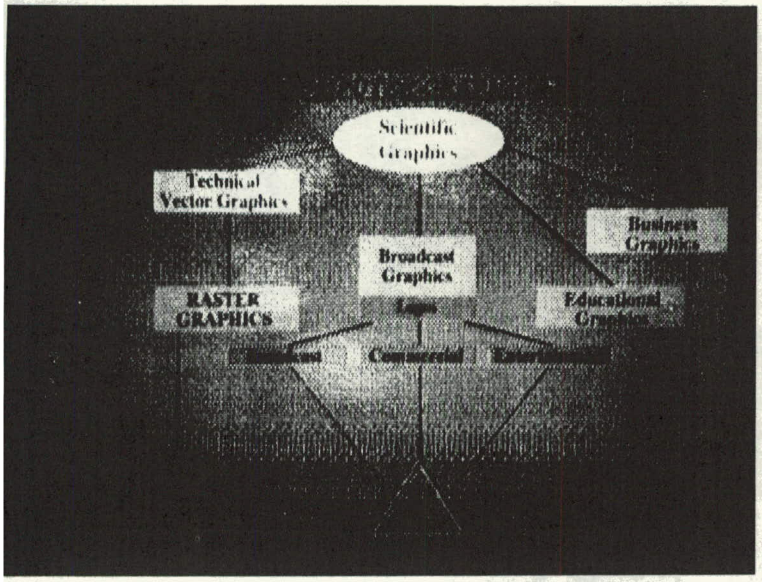
JIM BLINN: I mean, I see it as a difference between ... in music -- the difference between improvising and composing music and both of them are necessary. I don't like doing real time stuff myself because I don't think I'm particularly good at it. Basically, you have to perform the animation as it's seen. I rather like the idea of laying it out and fiddling with the timing and looking at it and saying, "No. This should be a little bit slower here." And fiddling with the timing again and so forth. So for me, real time is not that great a goal.

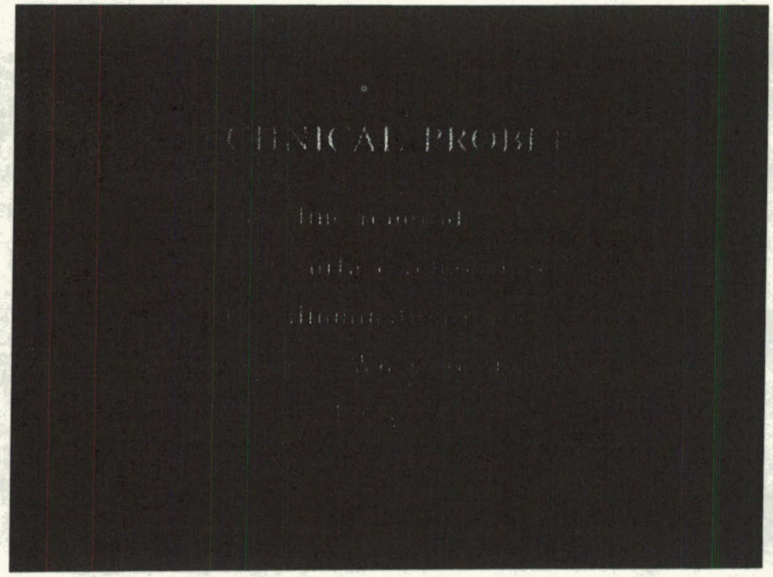
NANCY ST. JOHN: Anyone else have anything to say for real time?

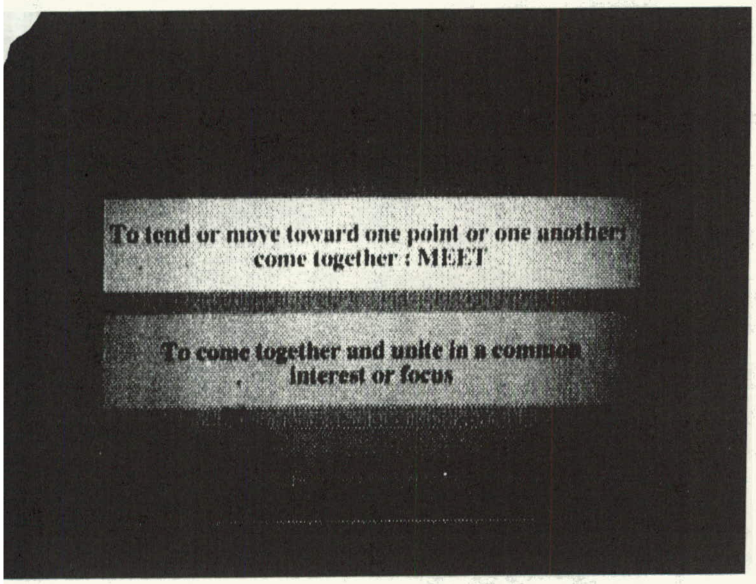
BILL KOVACS: I had a chance to enjoy recently, some of this stuff that Disney's been doing with new technology, I mean, in their theme parks. And the kind of thing you were talking about with the head-mounted display, kind of reminds me of the new George Lucas ride there that really employs what is now very standard simulation technology.

In that case, literally by the same companies that build them -- the flight simulators. And I think what's interesting is the transition that's going on there. If you look at some of those rides out of Disneyland, you're noticing a transition to a lot more use of other technology and media as the preferred way of taking people into a different reality.

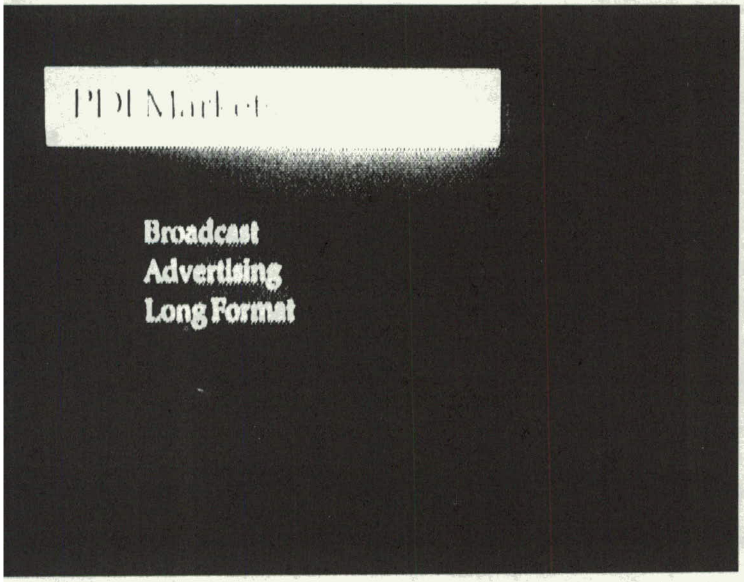
NANCY ST. JOHN: Well, I'm afraid I have to wrap it up. I'm getting the high sign. I'd like to thank you all for being a wonderful audience and for being with us here, today.

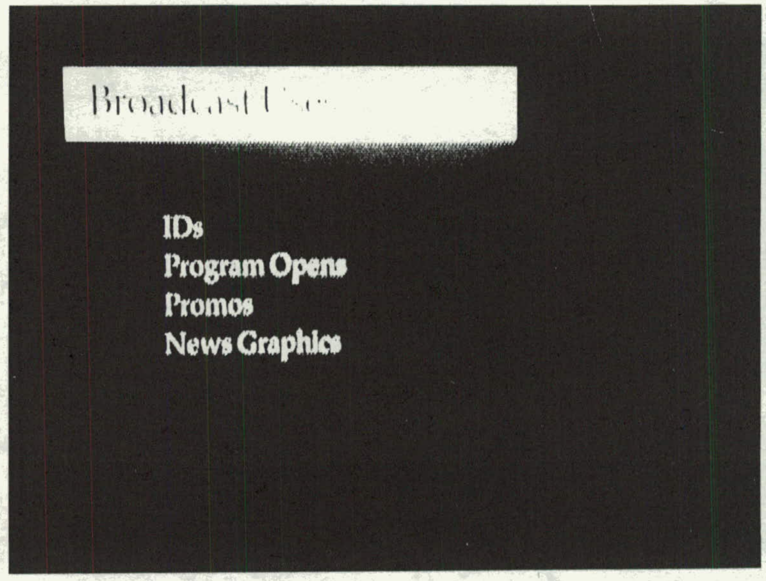


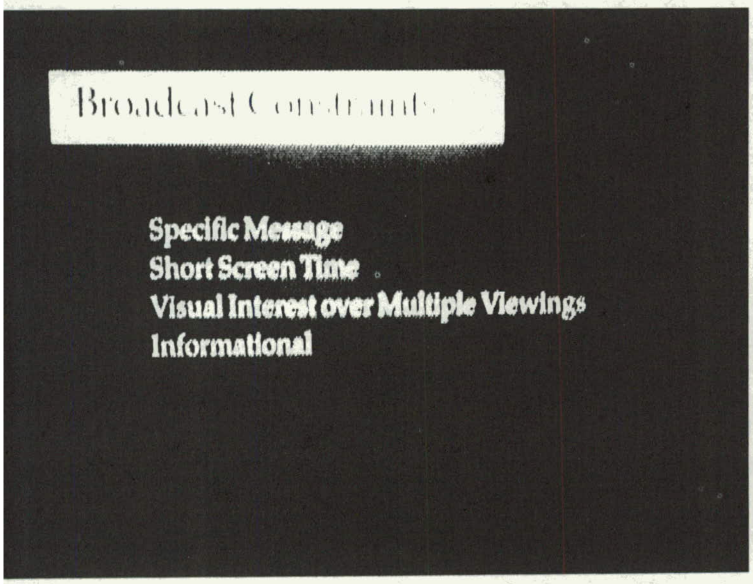


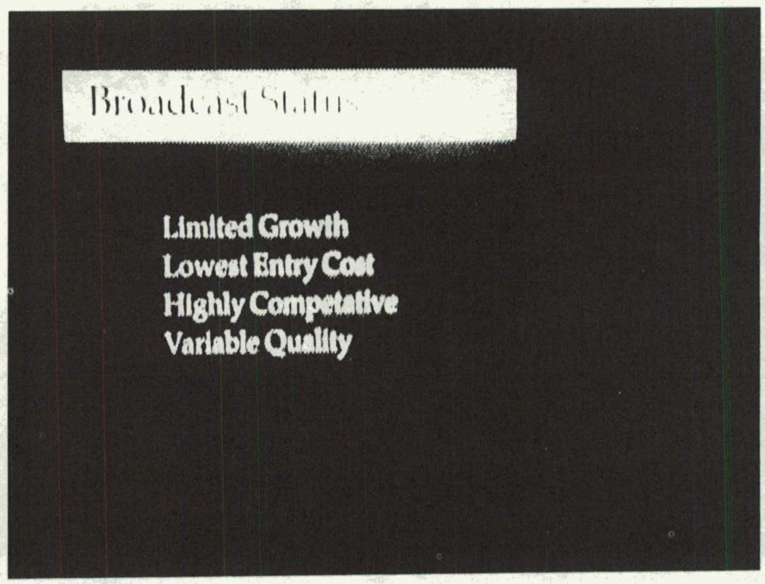


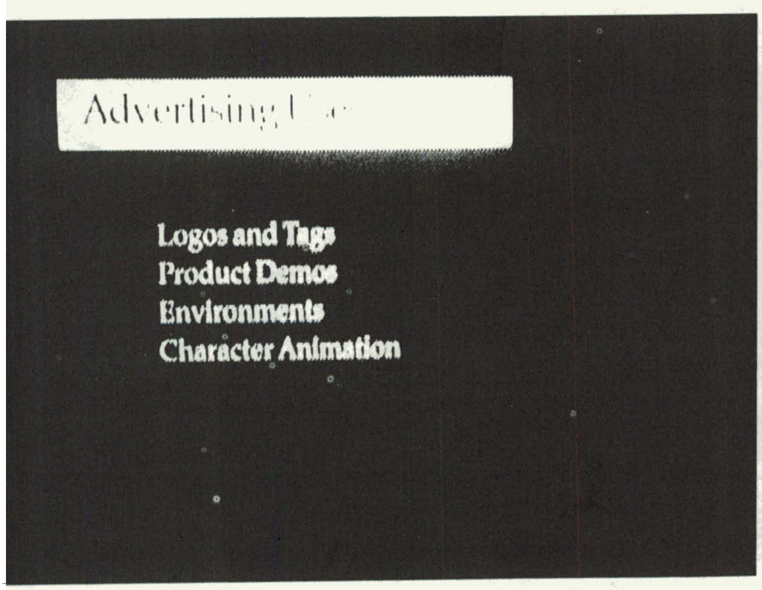
Nancy St. John

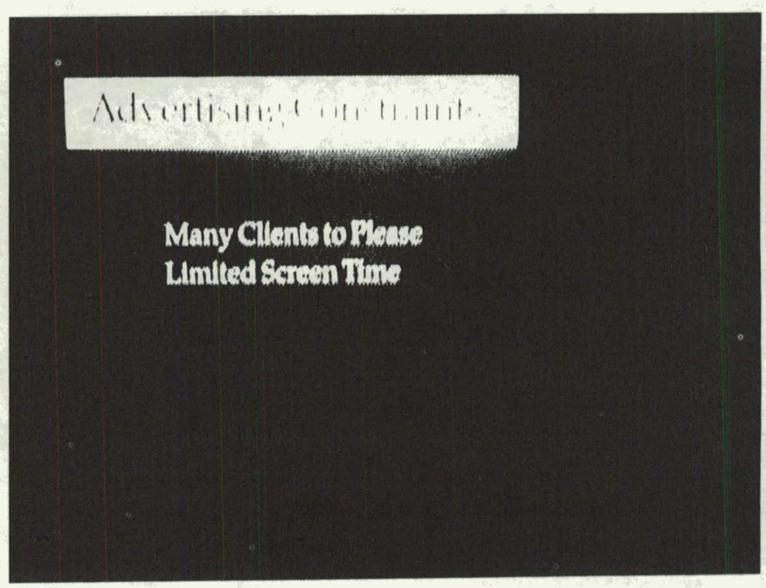




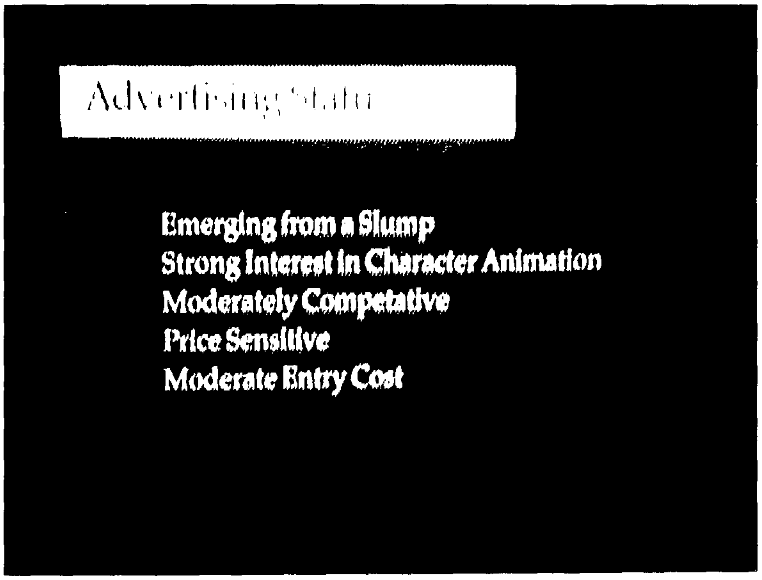


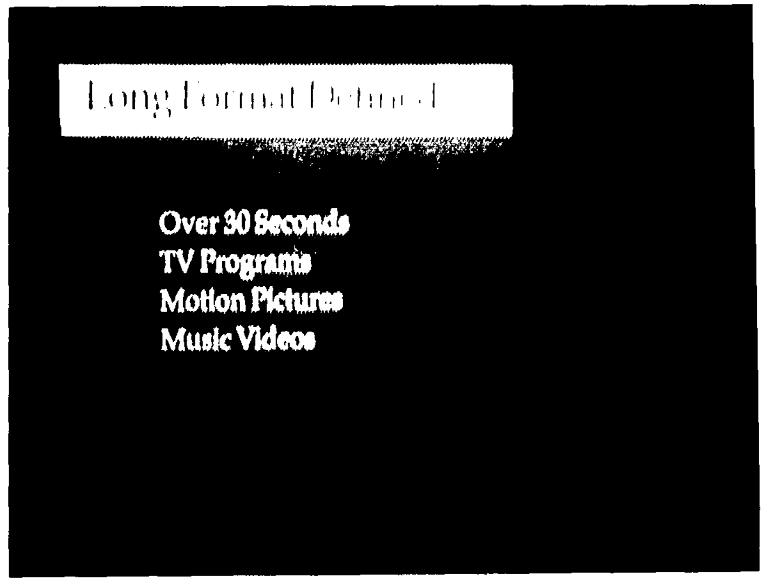


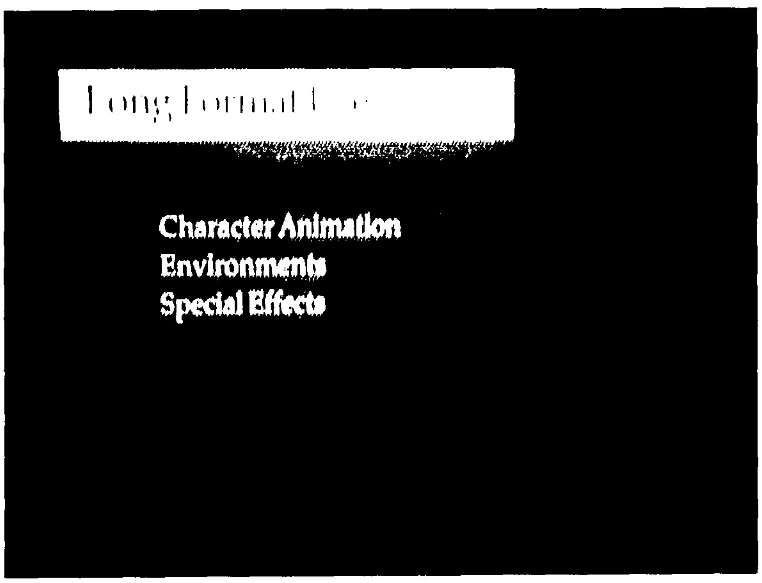


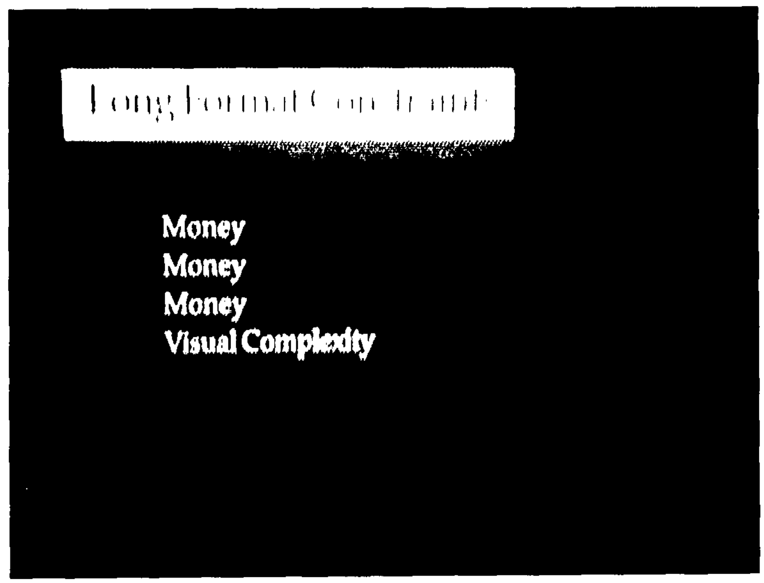


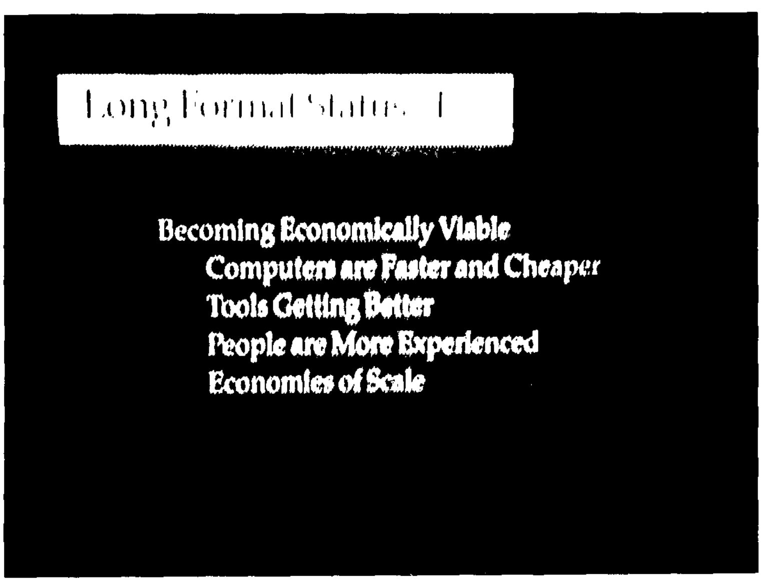
Carl Rosendahl

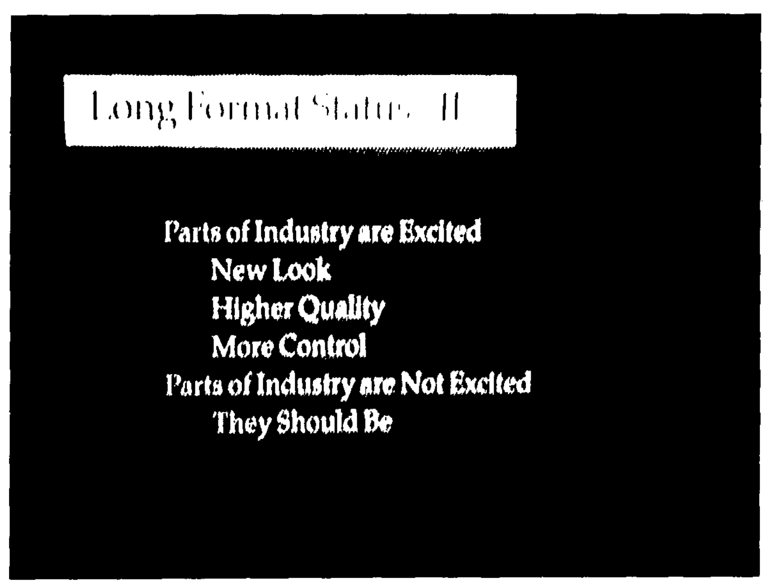

Advertising
Emerging from a Slump
Strong Interest in Character Animation
Moderately Competative
Price Sensitive
Moderate Entry Cost

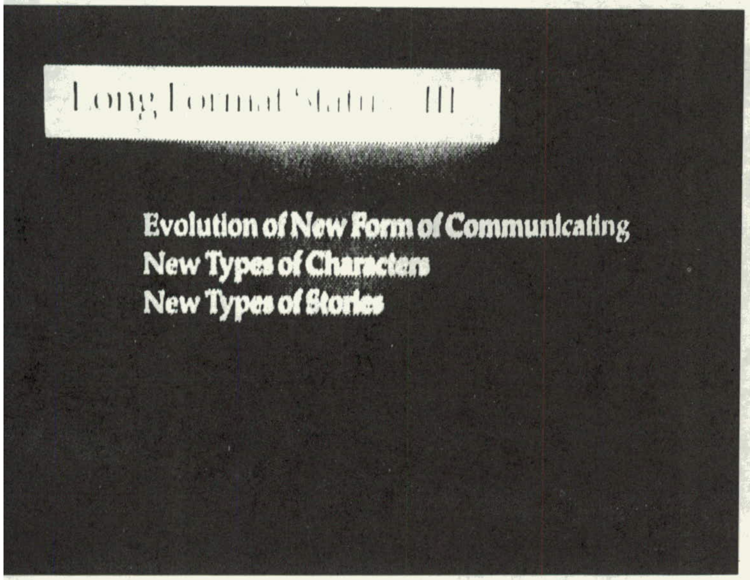

Long Format
Over 30 Seconds
TV Programs
Motion Pictures
Music Videos

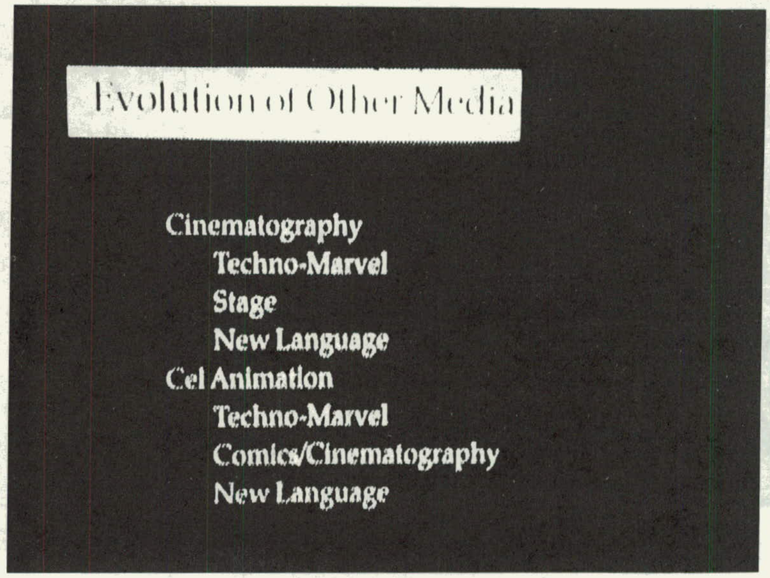

Long Format
Character Animation
Environments
Special Effects

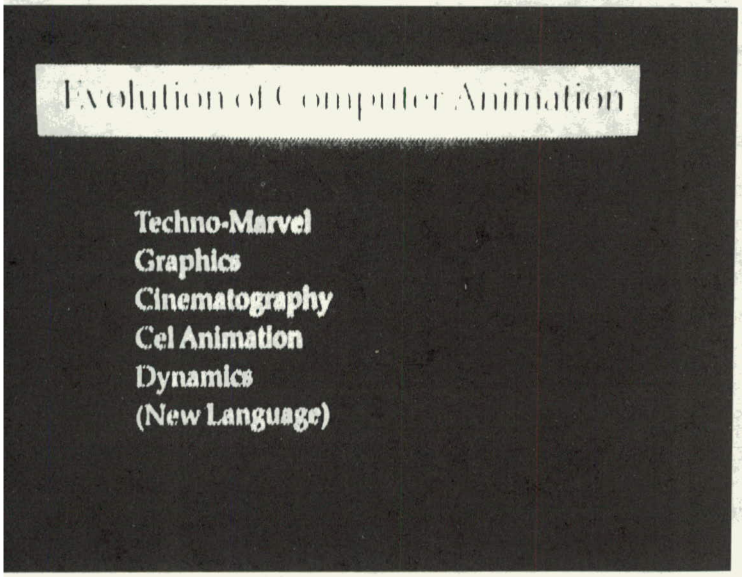

Long Format
Money
Money
Money
Visual Complexity

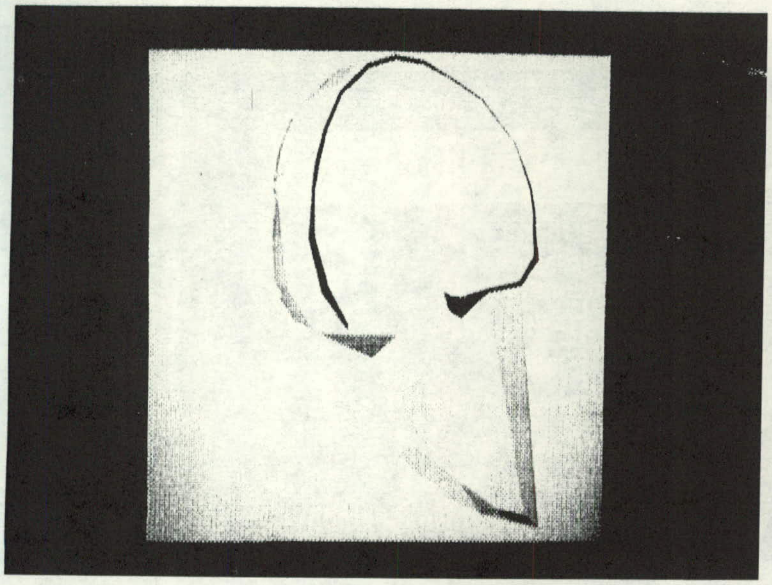

Long Format Status - I
Becoming Economically Viable
Computers are Faster and Cheaper
Tools Getting Better
People are More Experienced
Economies of Scale

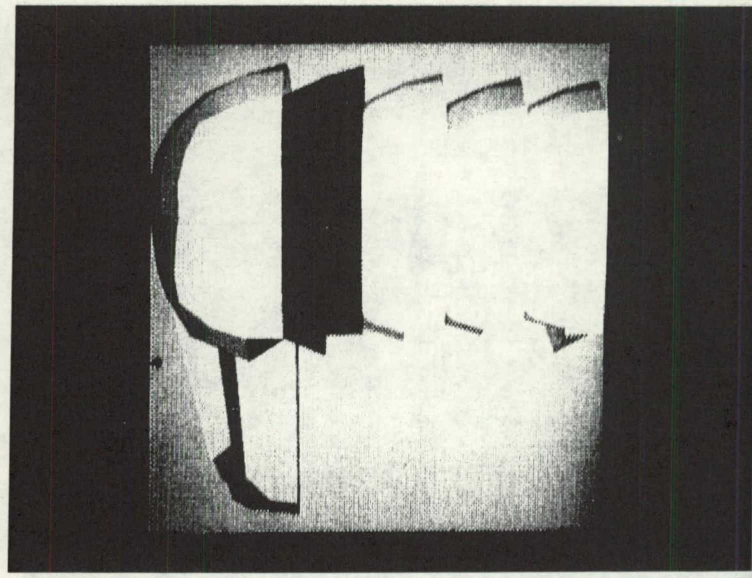

Long Format Status - II
Parts of Industry are Excited
New Look
Higher Quality
More Control
Parts of Industry are Not Excited
They Should Be

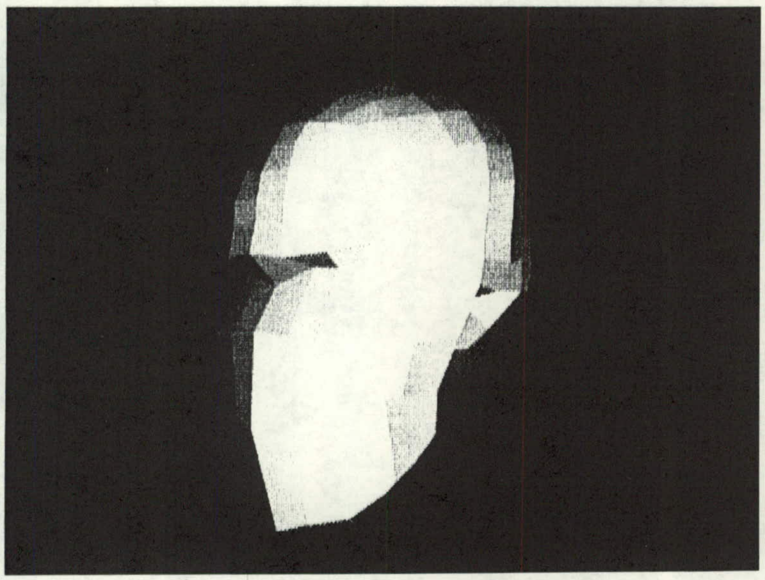

Long Format Status III
Evolution of New Form of Communicating
New Types of Characters
New Types of Stories

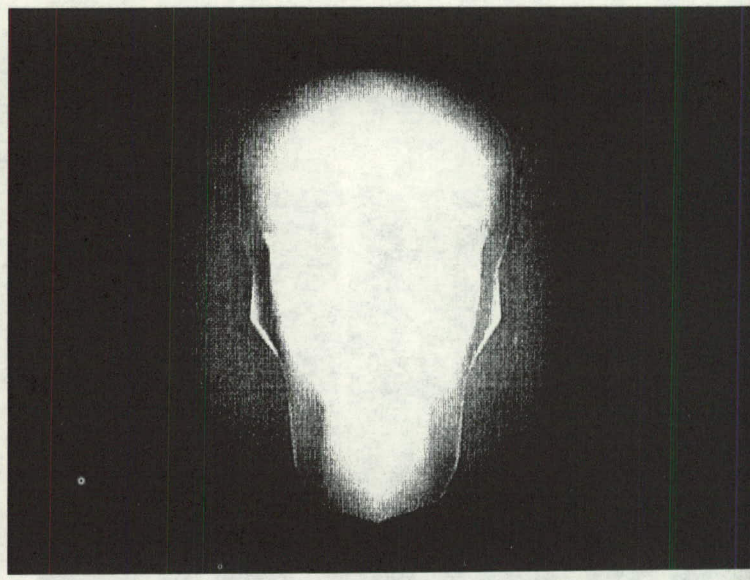

Evolution of Other Media
Cinematography
Techno-Marvel
Stage
New Language
Cel Animation
Techno-Marvel
Comics/Cinematography
New Language

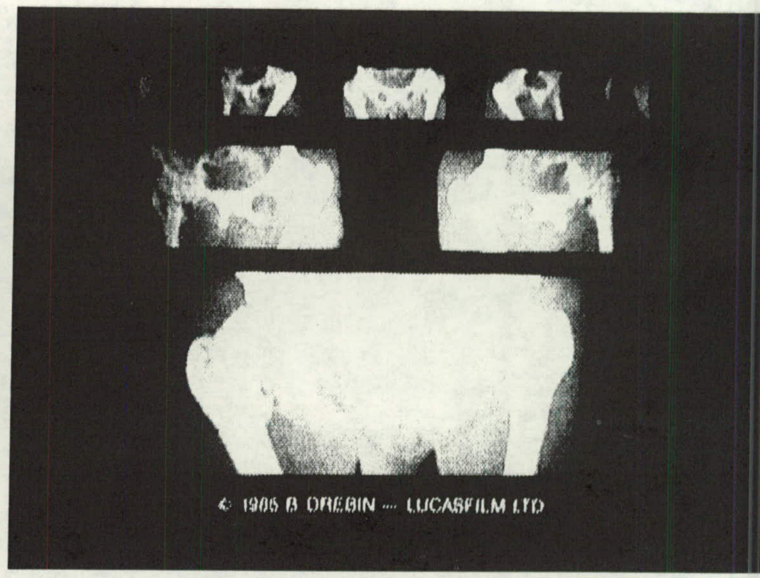

Evolution of Computer Animation
Techno-Marvel
Graphics
Cinematography
Cel Animation
Dynamics
(New Language)



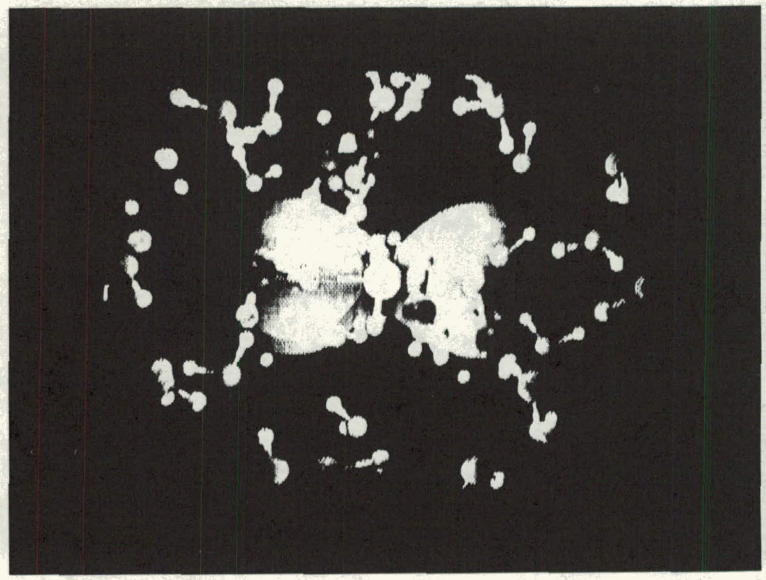
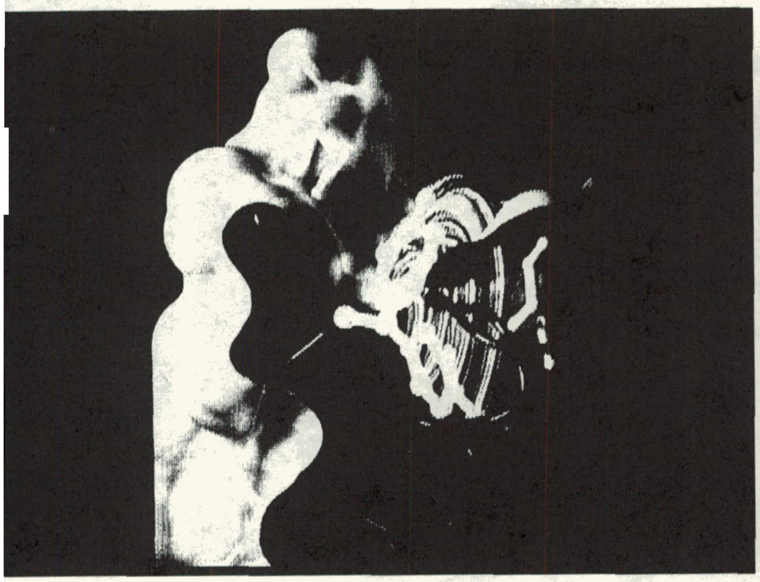
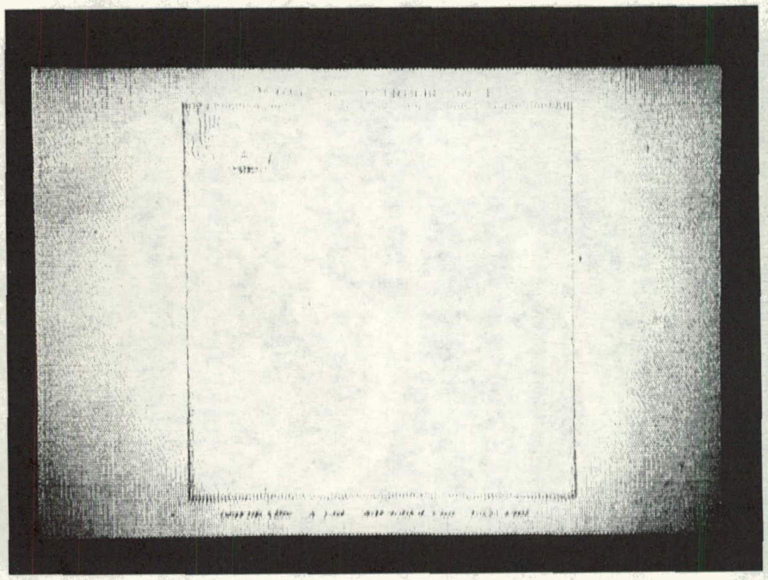
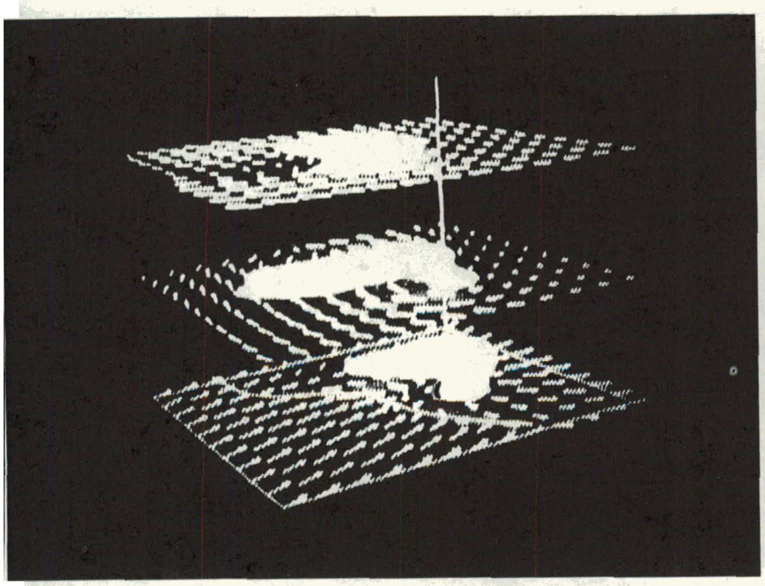
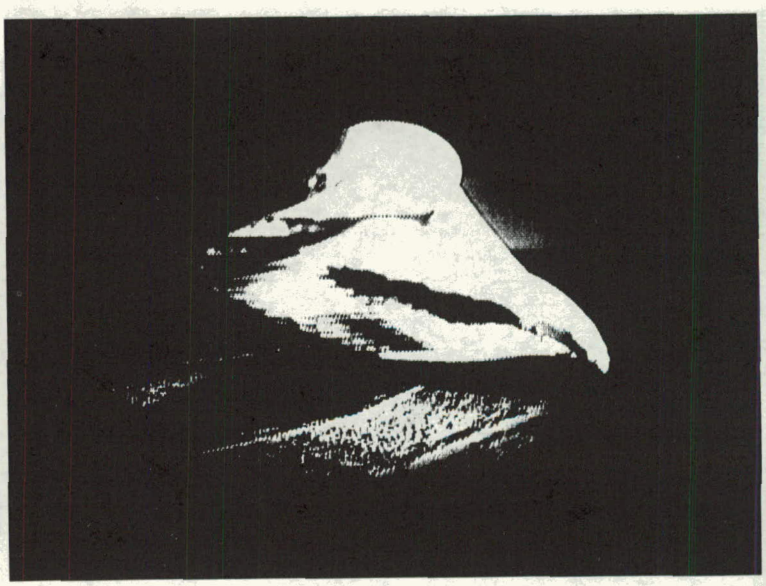




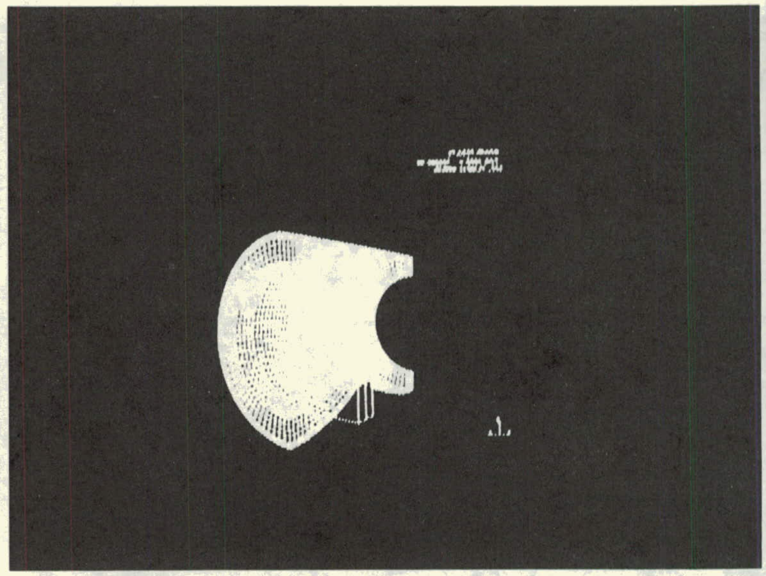


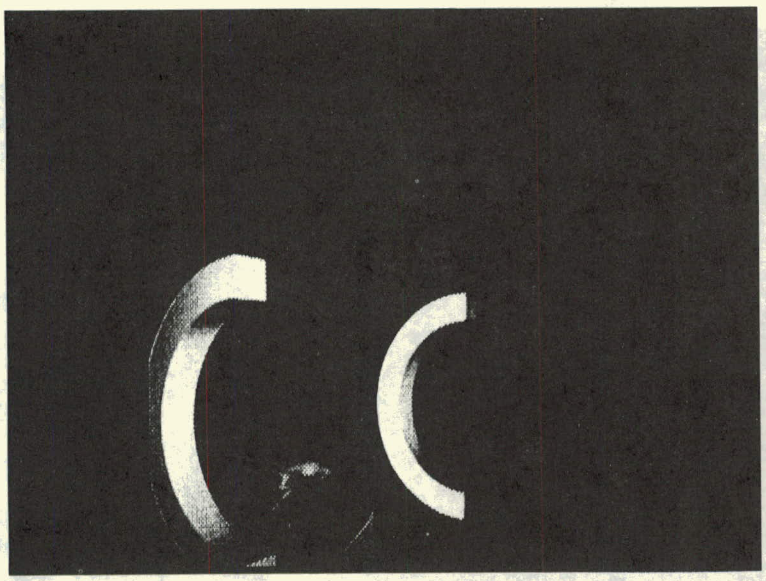


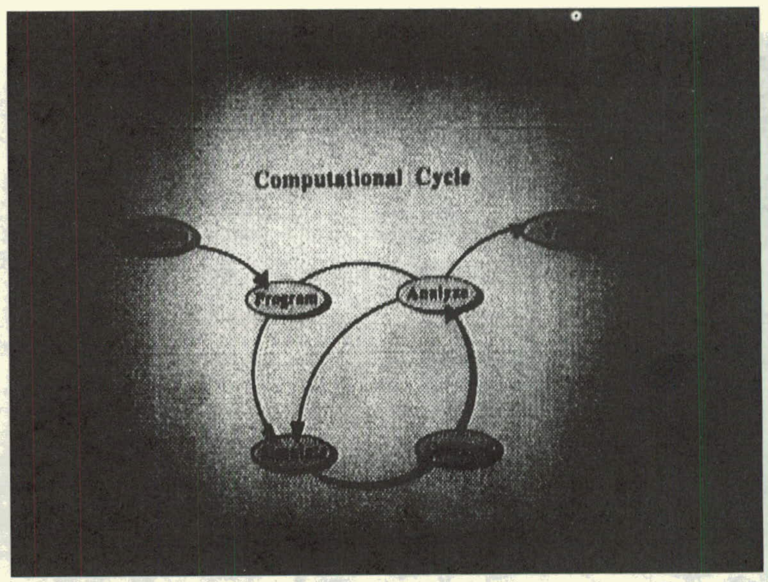
Craig Upson

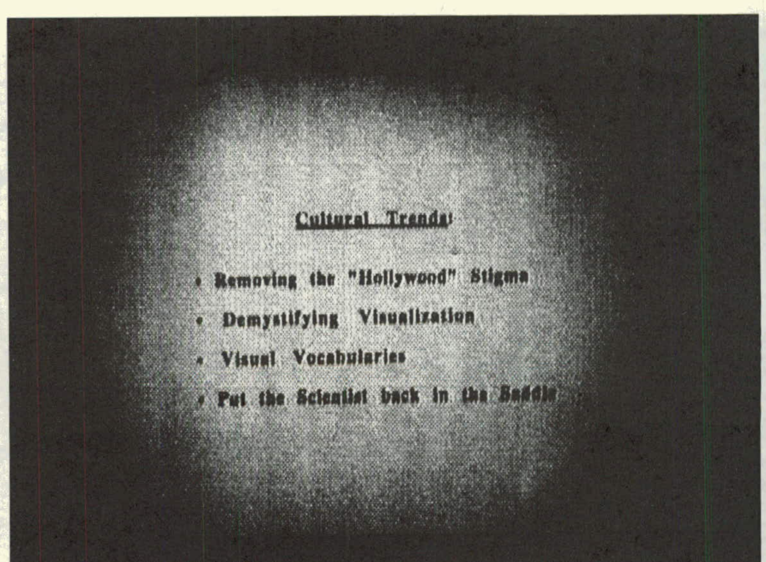







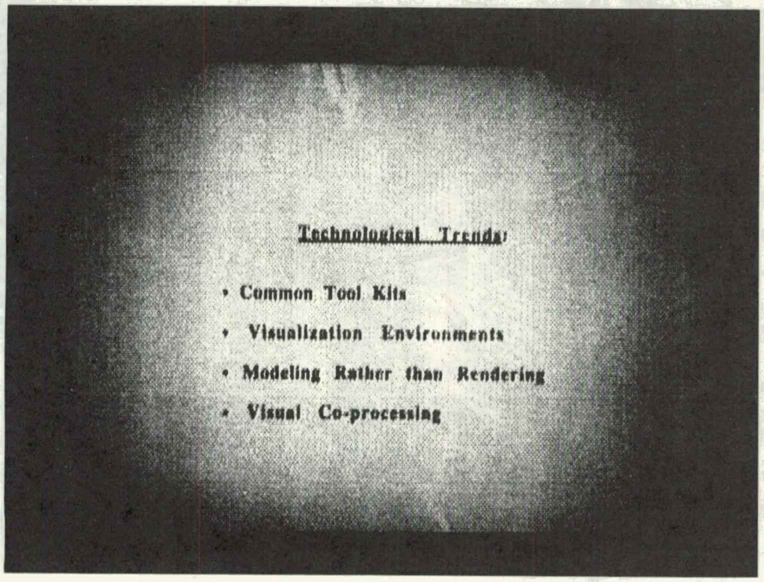
Craig Upson

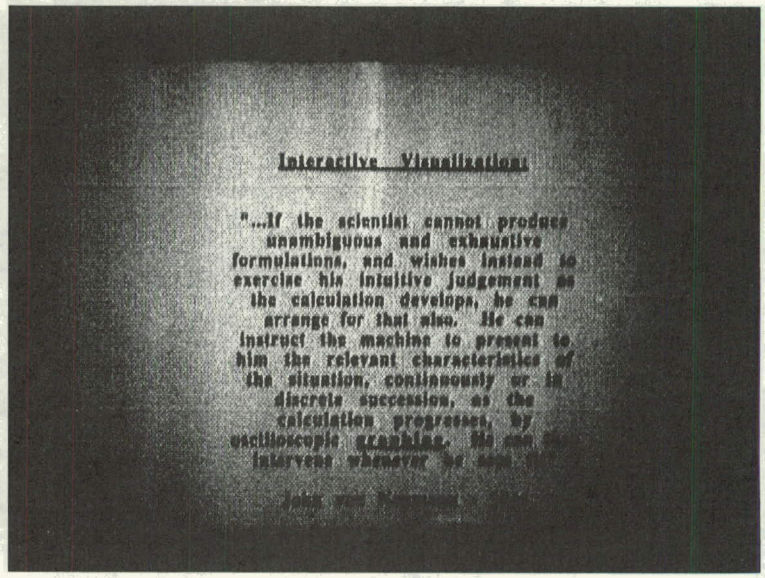


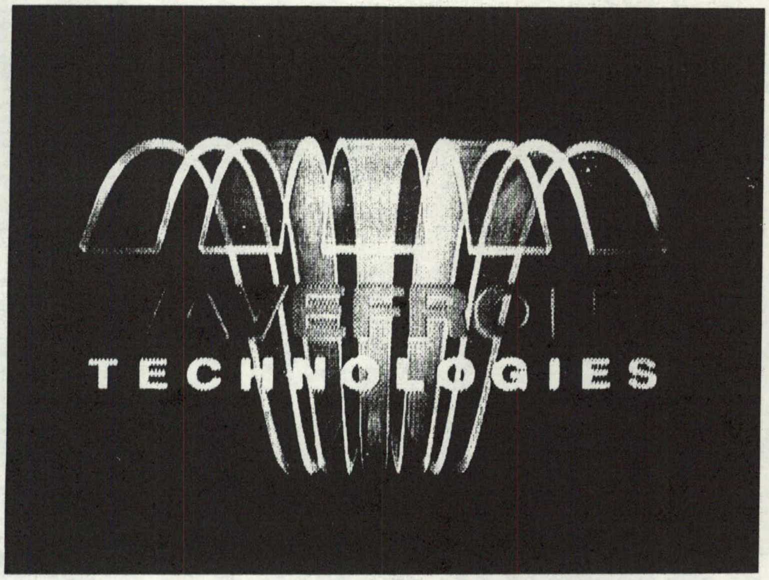


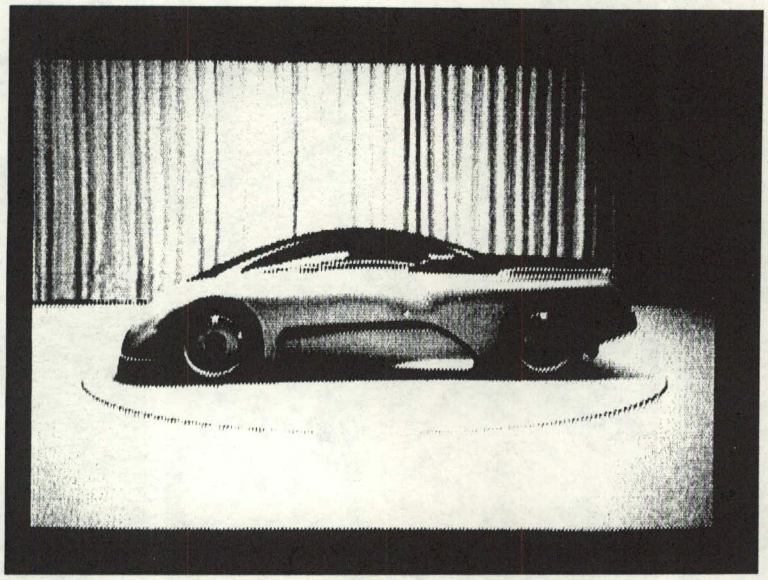

Computational Cycle
Program
Analyze

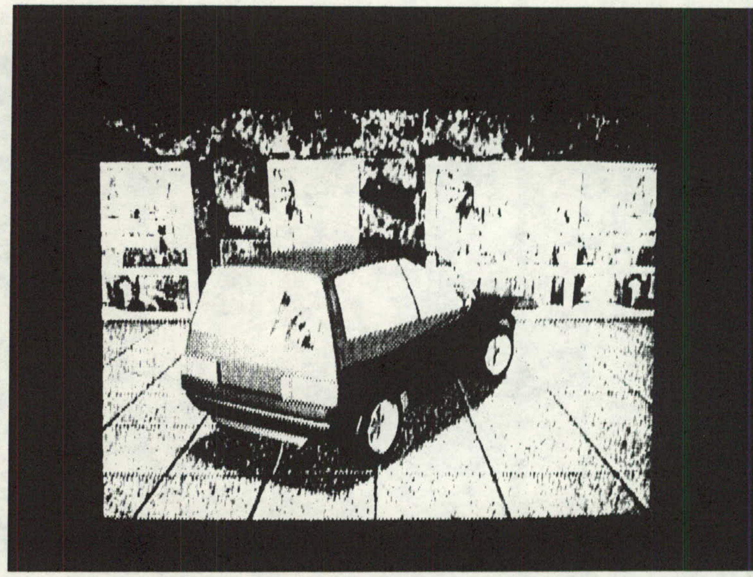

Cultural Trends:
• Removing the "Hollywood" Stigma
• Demystifying Visualization
• Visual Vocabularies
• Put the Scientist back in the Saddle

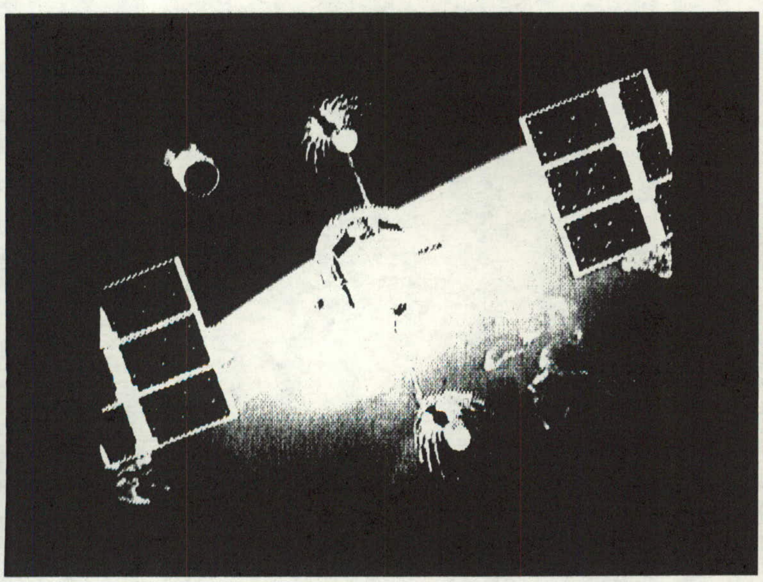

Technological Trends:
• Common Tool Kits
• Visualization Environments
• Modeling Rather than Rendering
• Visual Co-processing

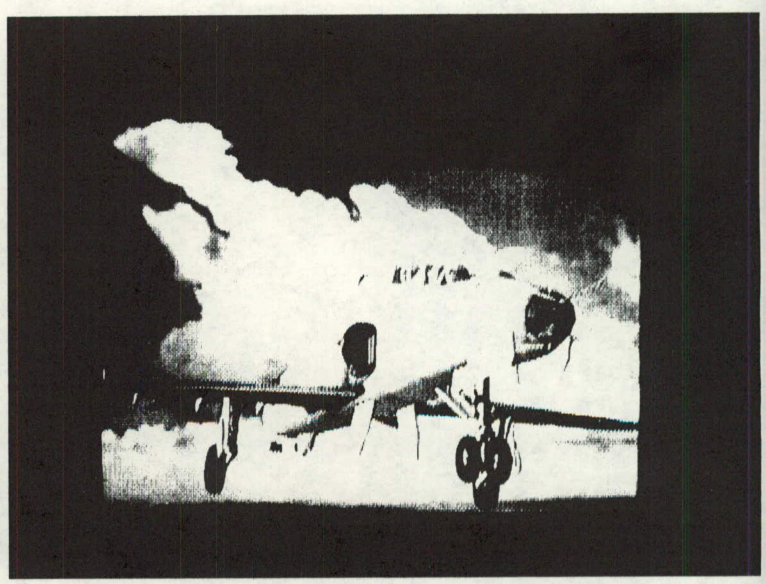

Interactive Visualization:
"...If the scientist cannot produce unambiguous and exhaustive formulations, and wishes instead to exercise his intuitive judgement as the calculation develops, he can arrange for that also. He can instruct the machine to present to him the relevant characteristics of the situation, continuously or in discrete succession, as the calculation progresses, by oscilloscopic graphing. He can
intervene whenever he
John von Neumann



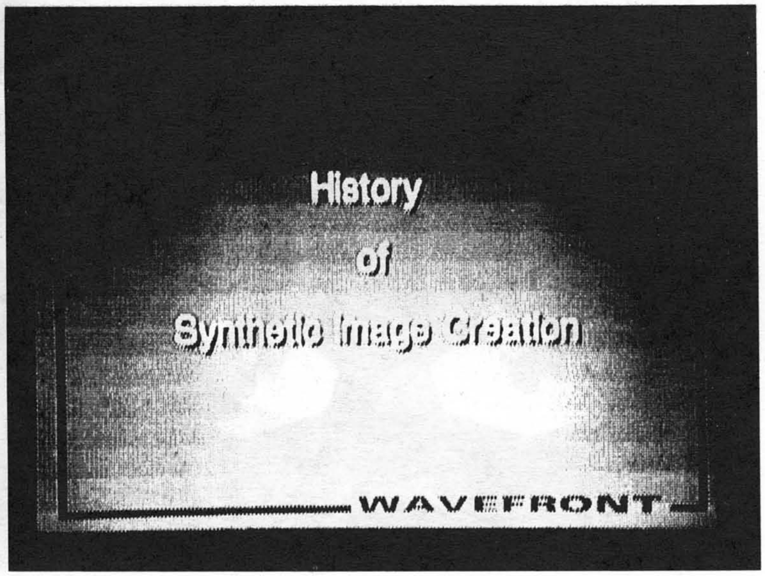


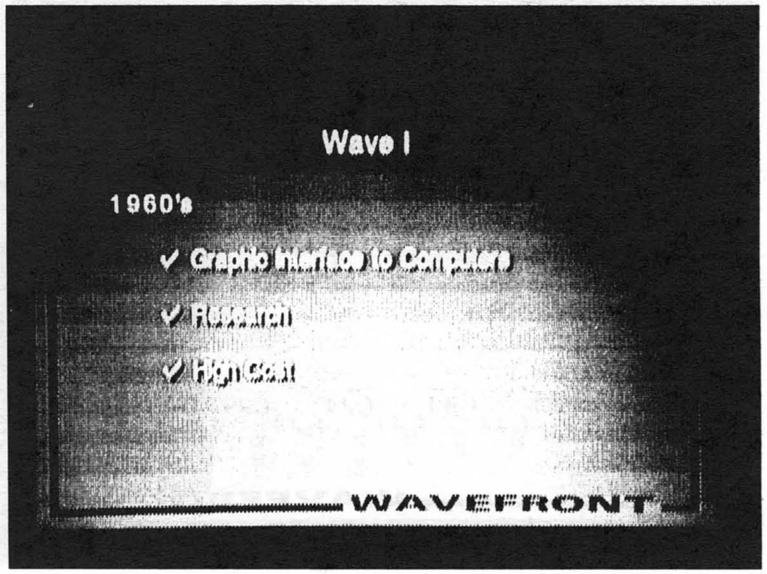


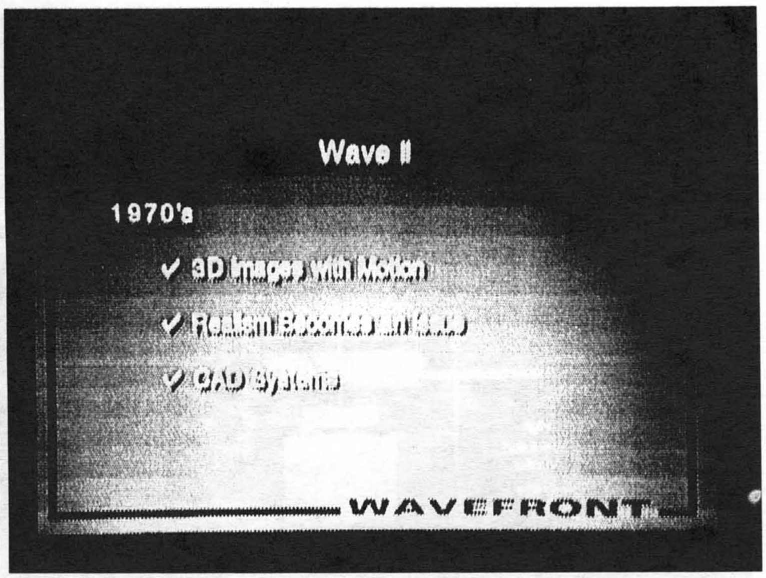


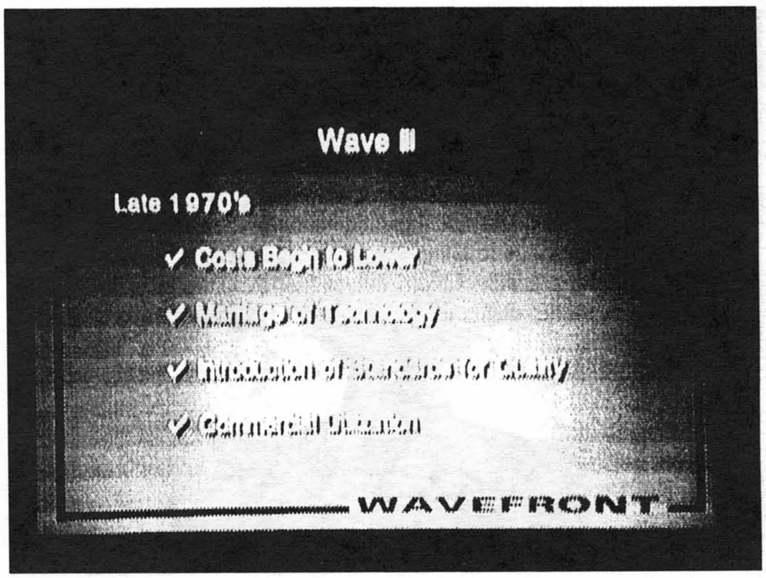


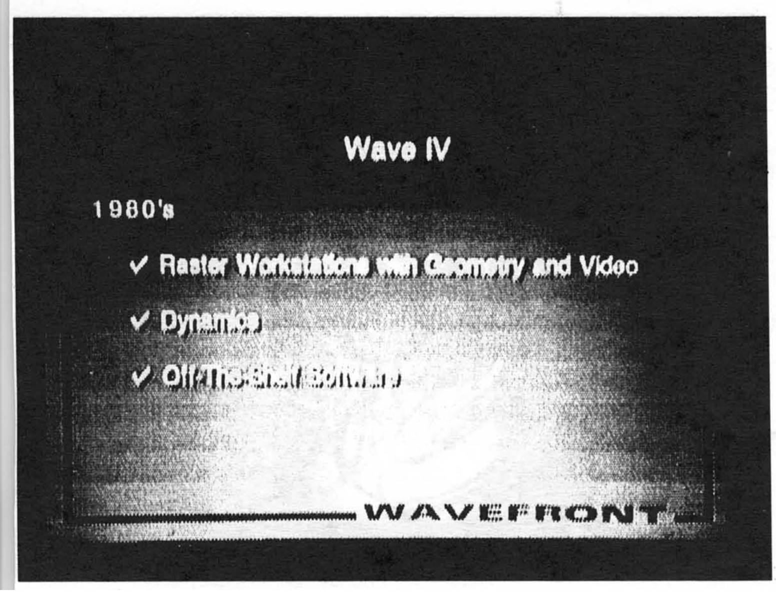
Bill Kovacs

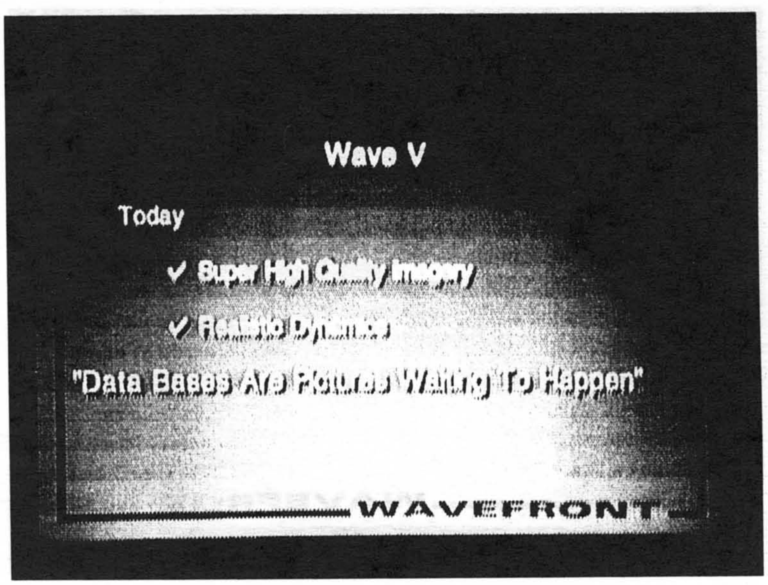

History
of
Synthetic Image Creation
WAVEFRONT


Wave I
1960's
✓ Graphic Interface to Computers
✓ Research
✓ High Cost
WAVEFRONT

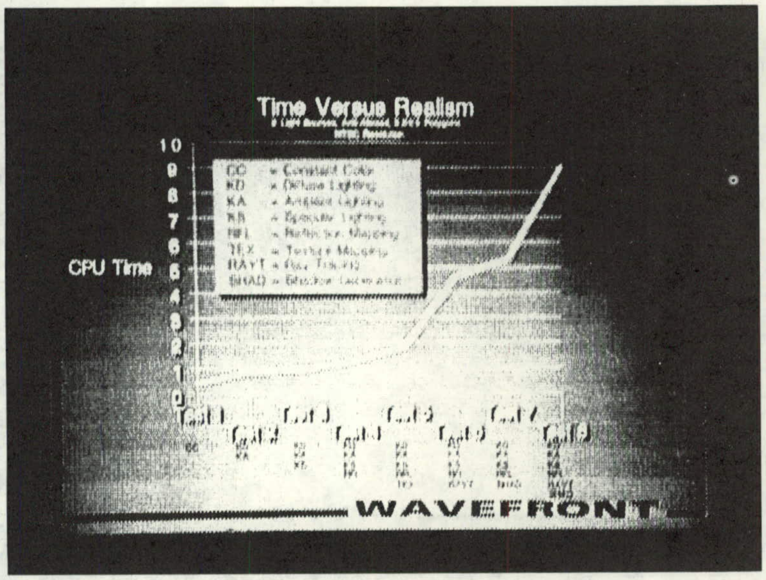

Wave II
1970's
✓ 3D Images with Motion
✓ CAD Systems
WAVEFRONT

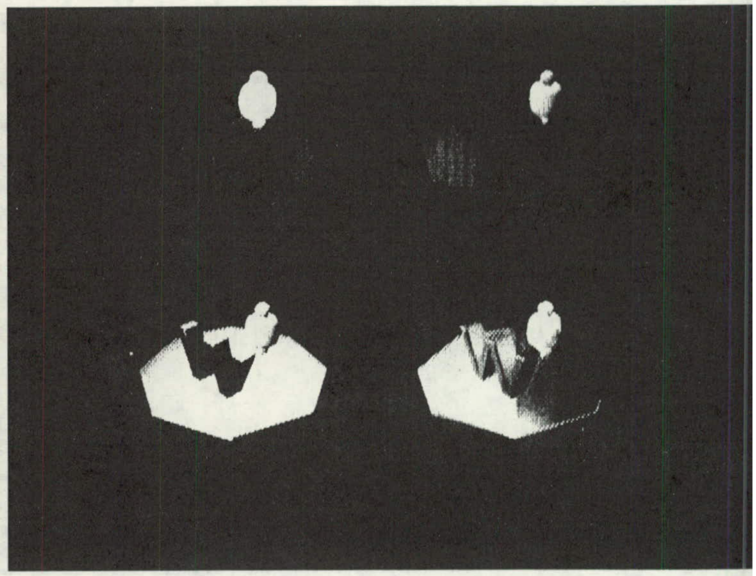

Wave III
Late 1970's
✓ Costs Begin to Lower
✓ Marriage of Technology
WAVEFRONT

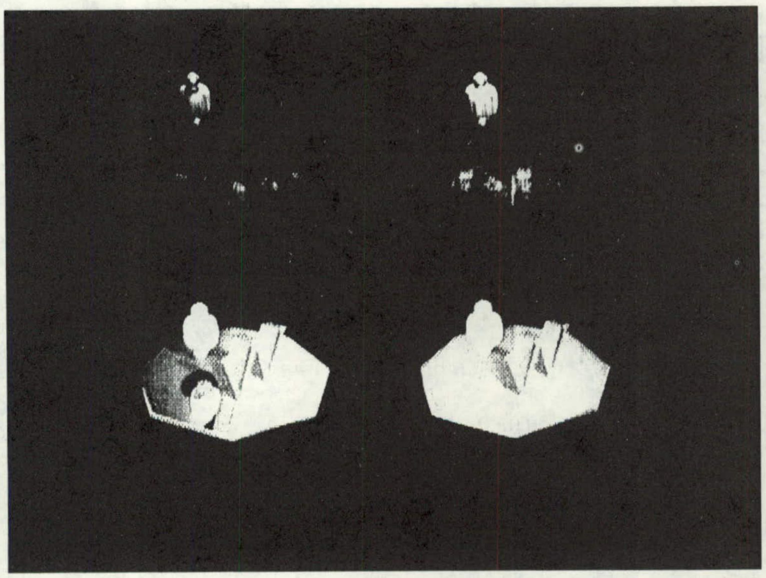

Wave IV
1980's
✓ Raster Workstations with Geometry and Video
✓ Dynamics
✓ Off-The-Shelf Software
WAVEFRONT

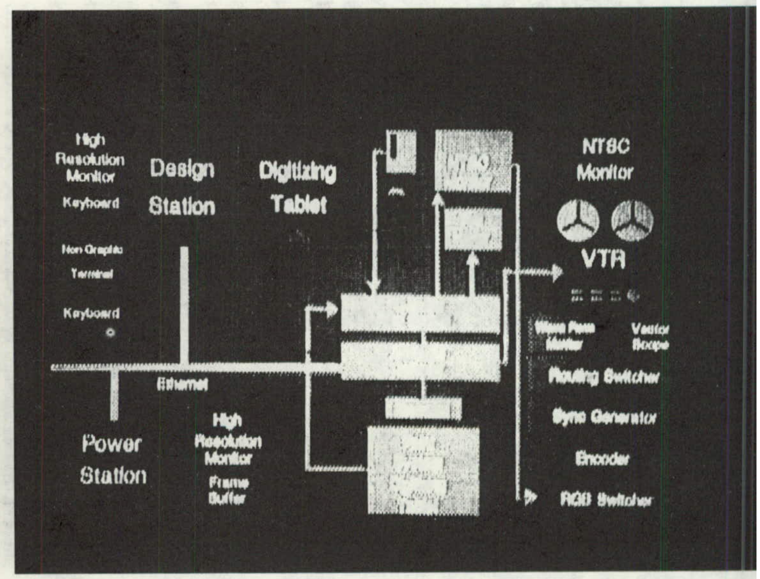

Wave V
Today
✓ Super High Quality Imagery
✓ Realistic Dynamics
"Data Bases Are Pictures Waiting To Happen"
WAVEFRONT

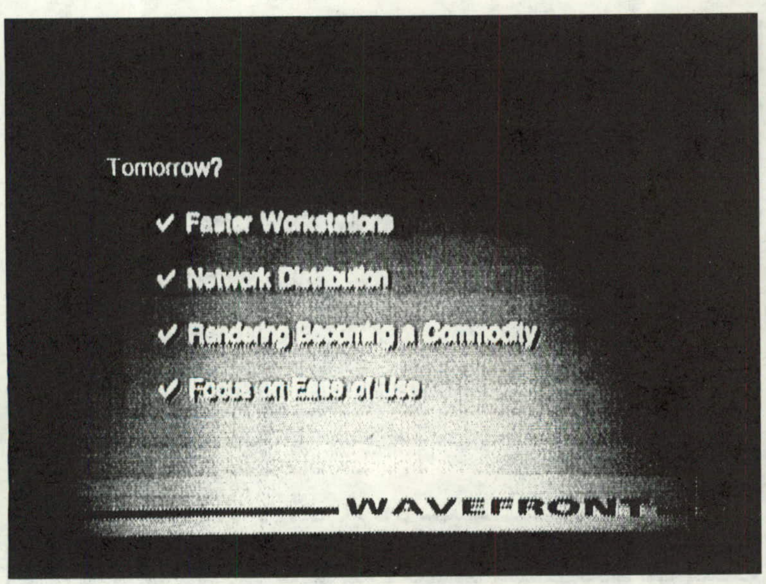
Bill Kovacs

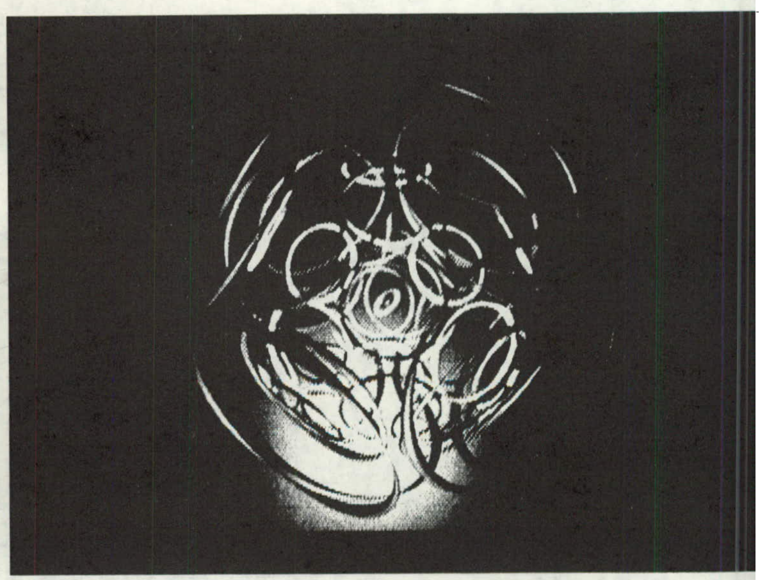

Time Versus Realism
CPU Time
10
9
8
7
6
5
4
3
2
1
0
CC = Constant Color
KD = Diffuse Lighting
KA = Ambient Lighting
TEX = Texture Mapping
RAYT = Ray Tracing
WAVEFRONT



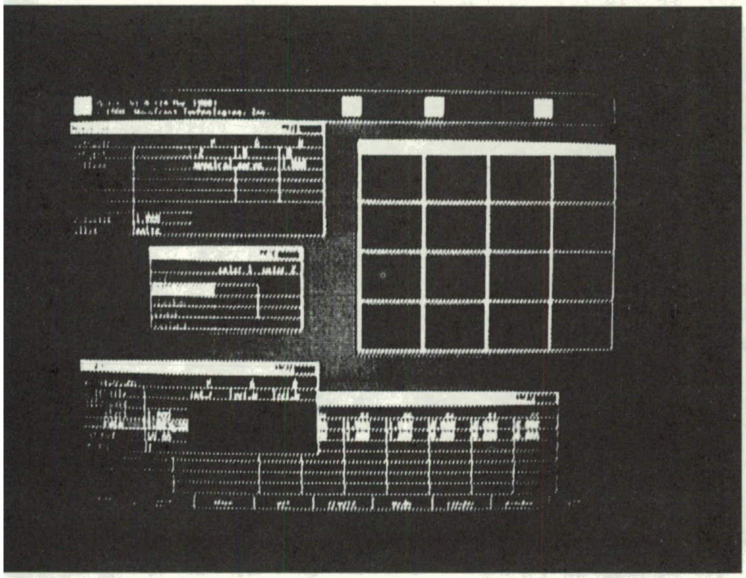
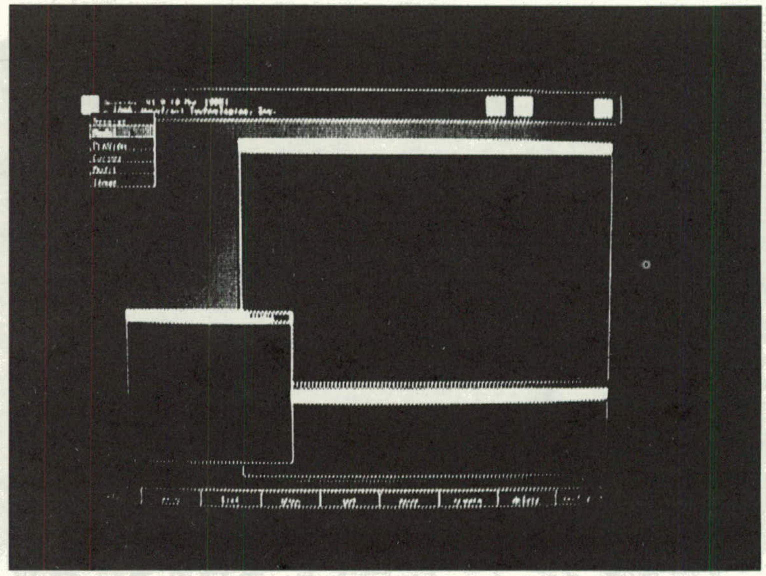



High Resolution Monitor
Keyboard
Design Station
Digitizing Tablet
NTSC Monitor
VTR
Non Graphic Terminal
Keyboard
Wave Form Monitor
Vector Scope
Ethernet
Routing Switcher
Sync Generator
Power Station
High Resolution Monitor
Frame Buffer
Encoder
RGB Switcher


Tomorrow?
✓ Faster Workstations
✓ Network Distribution
✓ Rendering Becoming a Commodity
✓ Focus on Ease of Use
WAVEFRONT



Bill Kovacs

Bill Kovacs