

tips

Computers and Animation

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on film and video

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Tony Apodaca & Flip Phillips

An informal chat with two of Pixar's old hands

Interview by Emru Townsend

Animation is usually associated with life; hardly surprising, since the word originates from the Latin *animare*, meaning "to give life to." Computers, on the other hand, are generally thought of as cold, lifeless, or inhuman.

As a consequence, when the twain met, many thought that the result would be animation, but cold and lifeless. And, for the most part, the sceptics were right. Early experiments with computer animation were, for the most part, aesthetically pleasing, sometimes even stunning; and while they provided the most dynamic and precise tilts, pans, and zooms, they lacked the life of even the simplest of characters animated by hand in the earliest part of the century. The epitome of this style was the flying logo: in the mid-1980s, it was hard to flip channels without coming across at least one of these shiny, chrome corporate IDs that were striking the first time, pleasing the second, and downright boring the third.

And then along came Pixar—sort of. The computer animation division of Lucasfilm which eventually became Pixar was headed up by ex-Disney animator John Lasseter. His mandate was to apply traditional animation techniques—squash, stretch, anticipation—to computer animation production. This manifested itself in 1984's *Andre and Wally B*, a wholly computer-animated short that featured two characters who looked, moved, and acted as though they were in a traditional cartoon. Later came *Luxo Jr.* and *Red's Dream*, both of which featured ordinarily inanimate objects—two Luxo lamps, a red unicycle—convincingly portraying hope, joy, pride, and despair.

Flip Phillips and Tony Apodaca were both part of Pixar since its early days, and both have worked in reconciling the malleable world of the artist with the more rigidly defined world of the computer. We spoke via Internet e-mail (unsurprisingly) between June 1994 and January 1995. Here's what they had to

say on art, computers, and what the kids look like after they're married.

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Emru Townsend: *Tell me a little about yourselves and how you came to be here.*

Tony Apodaca: Once upon a time, in a little town called... oops, wrong story.

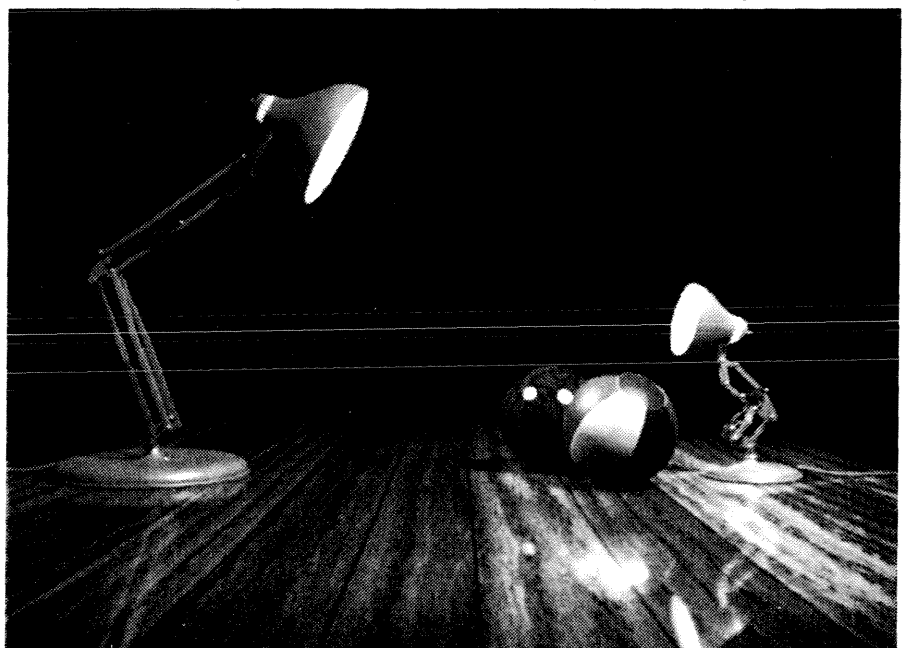
My name is Tony Apodaca, and I work at Pixar. My official title is Director of Engineering, which means that I'm a middle manager whose job functions include "keeping projects ahead of schedule and under budget", and the ever popular "hiring and firing." All of Pixar's end-user applications fall under my auspices, including the low-end PC and Mac applications like Typestry and Showplace, as well as the high-end products such as RenderMan.

My unofficial title is Chief Architect of RenderMan, which means that secretly I'm a Real Engineer. I personally worked

on the RenderMan project in its various forms and incarnations for over 6 years (well, still working on it, I guess), and as Lead Engineer for 4. Since 1989 I have been personally in charge of the sanctity of the RenderMan Interface Specification, but as it has not changed a lot in that time, I guess that's not much of a claim to fame.

In 1993, seven of us won an Academy Award for "the development of RenderMan software, which produces images used in motion pictures from 3D computer descriptions of shape and appearance." Mine sits on the bookshelf in my office, a knickknack that not many engineers will ever have.

Over the years, I've also done quite a bit of work on "the other side of the fence" in Pixar's Animation Department. I worked on *Red's Dream*, *Tin Toy* and *Knickknack*, and on a few commercials here and there. My involvement in Animation has always been purely technical (renderer support, building models, writ-



Luxo, Jr. gazes adoringly at dad. Or mom. How can you tell, anyway?

© 1986 Pixar

ing shaders, debugging shell scripts, etc.). Damn it Jim, I'm an engineer, not an animator!

What else do you want to know? My masters degree is in Computer Engineering from Rensselaer Polytechnic Institute (RPI). I've been in computer graphics since 1983. I've met both Steve Jobs and George Lucas, though neither one would remember me. Oh, I'm one of the few surviving members of the elite group of people who actually programmed a Pixar Image Computer. Sometimes, just for fun, I lurk on the Internet, laughing mightily at the people who claim that *Jurassic Park* was done on an Amiga, or that the Listerine commercials were done by a little old lady in Texas on a PC (using 3D Studio no less!).

And last, but not at all least, I'm good friends with the single most influential person to ever work in computer animation—Flip Phillips...

Flip Phillips: You've been talking to my dad again, haven't you Tony? For years he had that copy of *Animation Magazine* we were on the cover of in the back seat of his car. I think he was stopping random people on the street and showing it to them... Perhaps in Portsmouth, Ohio I am the single most influential person to ever work in computer animation, thanks to him... sadly, he hasn't had a chance to visit the remainder of the Earth to convince the rest of the world...

I got my start at the Computer Graphics Research Group here at The Ohio State University (they like for us to point out the 'The' in the university's name, as if there is another 'Ohio State University.' If there were, I guess we'd be 'An Ohio State University' instead). Anyway, we had a pretty unique group back then (this is around 1983) since we were able to successfully combine scientists and artists, yielding more scientific artists and more artistic scientists. (Kinda sounds like it could be a slogan or something.) Chuck Csuri, one of the real forefathers of the computer art thing, was my mentor. I guess I came out a 'scientific artist'... not really a pure animator or artist, but also not an engineer either. I think it is a good mix.

After I got my BFA and taught for a year at CGRG, I left Columbus for Pixar back in '87 when it was just getting started. After about 6 months of working on the

user interface for a medical imaging project I joined the Pixar animation group full time, where I was bestowed with the title 'Animation Scientist.' I think I was somewhere around the seventh member of the group. Now there are 7 million or 70 or something like that, working in animation there.

I worked on the first commercial Pixar did, which was a little spot for Toppan Printing in Japan. I did technical direction and animation on about a dozen of the early commercials and on the film *Knickknack*.

My wife and I are characters under the couch in *Tin Toy*, that was pretty fun. It was a little dirty under there, balls of cat

"Keep chanting to yourself, 'The computer is only a tool, the computer is only a tool.'"

hair and such. We ended up using the characters on our wedding invitations, done on a letterpress from the 1800's. We did a lot of fun experimentation back then, 3D, lenticular images, etc. You couldn't ask for a more fun place to work, both people and task-wise.

I left the group in 1992 to get my Ph.D. here at OSU where I'm in the psychology department studying vision and aesthetics. We use a lot of computer graphics here for visual simulations and experiments so now I get to use it as a tool rather than as a job.

More recently, I've done a little work on the side for a company called Ion, we just finished the David Bowie *Jump* CD-ROM. We've got a few more in the works now, I think it is a rather cool new medium.

So how does one program (or engineer) for animation? How much of the animation process are you required to know? Or, how much is it a good idea to know?

FP: I'll back-door that answer by first citing a little bit of history...

One real unique thing about Pixar's animation system is that it was written to a FDA's (Former Disney Animator-John Lasseter's) specs by a couple of rather amazing programmers (mainly Bill Reeves and Eben Ostby). When you sit down to use it the 'feel' and lexicon of the system is similar to the way you do things when you're drawing or when you're shooting footage. The guys that created the system (and the additional people that are now expanding it) are very good at co-opting the knowledge of the animators, adding their unique knowledge, and in a glorious sun-shiny collaboration, producing a really good set of tools to work with.

I have drawn animation experience but I was only a user of the system. But I feel like if you are a programmer/engineer it's part and parcel of the job to be quite conversant, if not an expert, with the 'process' you are trying to 'engineer'. You might be able to make a system that animates happy-big-eyed-massive-pupil characters based on your blood pressure or foot muscle flexions... that in itself would be amazing. But you'd probably have quite a time getting drawn or stop motion folks to use it... it'd be a quite novelty though... might sell well back in Marin.

You kind of get into this revolution vs. evolution thing, though. Maybe toe twiddling is the ultimate way to animate and we just don't know it yet. It's not much fun just 'implementing' old ideas on a computer (well, for most people it isn't). Some evolution has to come of it or else it is a pretty boring effort. But to make that evolution or perhaps that rare revolution it's probably not a bad idea to stand on the shoulders of giants (or other really big things), know a little about how Frank and Ollie did it... [Frank Thomas and Ollie Johnston, two of Disney's legendary *Nine Old Men*. —Ed.]

So in summary, I'm a big 'as much as you can know' kind of person. If'n yer an animator it really can't hurt much to learn about how a computer works. It isn't requisite, but it can't hurt. Same goes for the engineering crowd with respect to animation. The end result is that both groups are able to converse in some mishmash of a common language. To be a good 'computer animator' you have to be a good 'animator'. 'Animator' is the key word there, not computer. Keep chanting to yourself, "The com-

puter is only a tool, the computer is only a tool", unless you're in Tony's shoes, in which case the mantra is "The computer is only a means for my existence, the computer is only a job." Or something like that...

TA: I agree whole-heartedly with Flip, although this is probably not surprising since we "grew up" together in the same organization.

There are lot of companies out there who take computer-savvy people, and try to make animators out of them. At Pixar, we take animators and give them computerized pencils. Animation is an art, typing is a skill. You are born with the ability or inability to animate, and in fact the really good animators in the world have all spent time experimenting with *lots* of different media—sketches, painted cels, stop-mo, clay—and computers are just another medium. Hey, we just had a puppeteer give a talk here, and most of the animators in the company had experimented with that, too!

One example: I just saw a demo reel from a small CG software company. It was really sad. It was clear that the reel was mostly a few programmers using their system, and while these things might be the most exciting animations those programmers ever personally did, they were *so bad*. You wanted to say, "Hey, my 3-year old can animate better than that!" And then on the reel there was one really good-looking piece, and if you immediately thought "Professional Animator", you were right.

When I say "a lot of companies out

there", I basically mean animation software development companies. Most of the production houses have learned (by watching Pixar or from hard knocks) that you need to hire animators, and reports are that the graduates of all the good animation schools are now descended upon in droves by CG production companies. Sure, there are not enough animators to go around, and so people do end up hiring a few non-animators-but-with-potential just to fill in the gaps, but they try.

However, the software still behaves as though the user is very computer-literate, and understands the details of computer graphics algorithms and research. Clearly, in order to sell a product in a

"There are lot of companies out there who take computer-savvy people, and try to make animators out of them."

cut-throat market, it is a cool thing to advertise "Inverse Kinematics." But what does that mean to a guy who just graduated from art school?

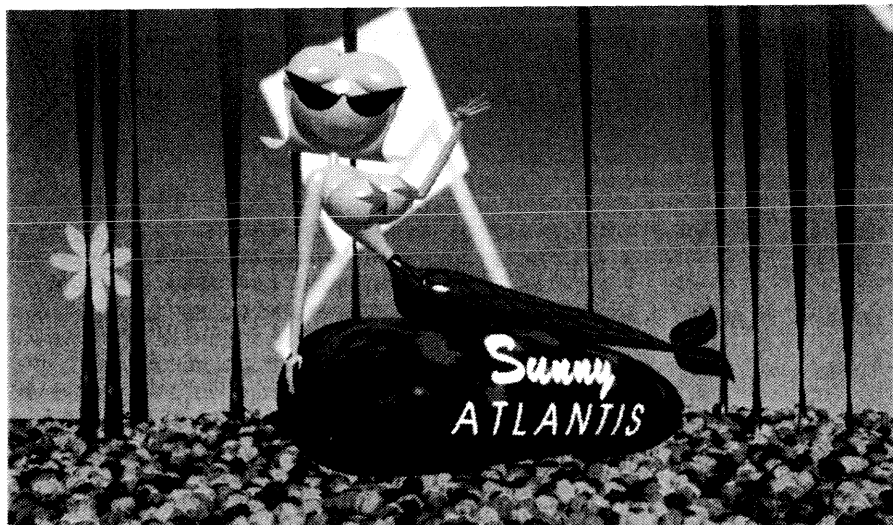
Now, let me clarify one thing, because Flip and I both glossed over this because it is second-nature to us. The Animation System at Pixar is not for animators. And

it is not for programmers. It is for animator-programmer teams. In every piece of an animation project, there is a person (called a TD) whose job it is to handle all of the programming tasks of the project. He writes hundreds of little programs to handle all phases of the animation (model, lighting, shading, physical dynamics, compositing, shell scripts, more shell scripts, etc.). He delivers to the animator a "model" which the animator animates. The animation system (as Flip said) is organized to let the animator work "in animation terms," without knowing anything about what weird relational database tricks or state-of-the-art CG research was done to provide that model. They go back and forth, the animator asking for certain extra "features", the TD providing the best he can with the technology at his disposal.

This division of labor gives each person the task that they are good at without burdening them with something they are not good at (and perhaps not interested in). Oh, sure, over time you do learn some of that stuff by osmosis, but you don't need to in order to do your job well.

So, you ask about engineering. As Flip mentioned, on any computer engineering project, be it aircraft flight controls, or supermarket inventory management, or computer graphics animation, you cannot be a good engineer unless you listen to your customer, understand his wants and needs, and provide a system which addresses his problem without burdening him with a bunch of your problems. Oh no, the Sybase Database can't handle more than 10,000 different UPC codes? Too bad, not his problem. You can't very well tell the supermarket to stop carrying more than 5 different mouthwashes. You have to solve your own technical difficulties yourself.

And so it is in CG. If you are an engineer here, you address the needs of the animator without burdening him with the limitations of the computer, or forcing him to learn a lot of computer arcana which is superfluous to his task. This means that you need to learn a lot about how animation is done, even if you are not very good at it yourself. You learn about what animators enjoy and want to do themselves, what they think is boring and would rather have handled automatically, how they were trained to use their traditional tools and what peeves they



Knickknack's object of snowman lust.

© 1989 Pixar

have about them. And you will probably never, ever do any real animation yourself.

And I can guarantee, the animators will never write any shell scripts, either.

Both of you have watched CG animation grow from a curiosity to a gazillion-dollar industry. We've had T2, Black or White, and Jurassic Park remind the general public that computer animation means more than ultrachrome flying logos.

Some people think the next phase of evolution is CG actors replacing live ones. Others think it just means special effects will get all the more sophisticated, so the suspension of disbelief in, say, the new Star Wars will be raised a notch.

Having watched things progress from the "inside", where do you think CG will go from here?

TA: CG has turned into a "gazillion-dollar industry" for exactly one reason: there are now two classes of visual effects for which executing the effect on a computer is more cost-effective compared to doing it any other way.

The first, most "mundane", and by far the largest class, is image composition. Computers are now able to scan images, digitally manipulate them in reasonably simple ways (warp, paint out imperfections, composite) and output them back to film more cost-effectively than the old hand-painting, rotoscoping and optical compositing. The fact that the digital manipulations are in some ways "cooler" than the optical manipulations is incidental. The speed of mid-1990's computers and quality of mid-1990's CCD cameras (the guts of modern scanners) have finally crossed the cost curve of old-fashioned manipulations. Note that for *really* simple manipulations (say, just a straight-up blue-screen composite) this is not yet true, but the effects houses are going 100% digital anyway because it will be soon.

The second class is extremely fanciful large-scale fully-articulated creatures, e.g. the water-weenies, T-1000s, and dinosaurs. These are *only* cost-effective on a computer because the other potential technologies (robots, makeup, stop-mo, etc.) are very expensive themselves. A decent-looking robotic T-Rex costs several hundreds of thousands of dollars,

and can't walk. Stop-mo armatures are less expensive, but amazingly slow to animate (which equates to many months of salaries for animators). Computer animation systems are now faster than models for complex fully-articulated motion (again, not so for simple motion), and CG models are less expensive to build than robots.

So, when you ask, "What's next for CG?", you really have to consider what's still really expensive for a movie-maker. Honestly, I think that modelling everyday humans is a long, long way off. Despite the fact that a couple of my friends have been quoted as saying it'll happen in less than 5 years, and even assuming that modelling and rendering

"The time of 'glitz value' for CG is way over."

a realistic-looking human was already demonstrated to be possible (which it most categorically has not!), I still say look at the economics. Human actors are plentiful and cheap. Only really big-name stars make enough money to even worry about, and you can't very well replace *them* with a synthoid, because they are the definition of box-office draw.

As you know, at Pixar, we are working on a fully computer-generated full-length animated feature film. We are doing this because we believe that computer animation is now cost-effective relative to cel animation. Or at least, nearly so. There are several other companies who have come to this same conclusion, either independently or perhaps spurred by our belief. Again, this is only true for really high quality stuff, because it is really inexpensive to put together animation if you are willing to accept Saturday morning quality stuff.

My belief/prediction is that the true "next frontier" for CG is (don't laugh): pyro. *True Lies* has tens of millions of dollars of exploding buildings, bridges, vehicles, etc. These shots are really dangerous, tricky and one-shot-at-it affairs. It is not yet possible to get these effects by computer, but once it is, I'm sure we'll

beat their costs in pretty short order. Think of the savings on insurance policies alone! Remember, you heard it here first!

(Of course, true sticklers will remind me that we've already had the first CG pyro: exploding LA in *T2*. Most of that was miniatures, however, so it's just the first small step.)

Okay, Flip, what say?

FP: Interesting... I wasn't aware that that pyro was CG... 'mazing. I have to say, if there's one thing that leaving production has done, strangely enough, is that it has opened my eyes to some of the other stuff going on out there. Seems that when I was mainly doing production I was always caught up in whatever it was that we were doing, hell, I didn't have enough time to worry about other people's stuff... when a friend of mine showed me some of the footage in *Jurassic* that was CG my only reply was that of the proverbial deer in the headlights. (I have first hand experience with this phenomenon, by the way, but that's for me and my insurance company to deal with...)

I think Tony hit it right on the head with the price/performance distinction. One has to think rationally, and the time of 'glitz value' for CG is way over. In fact, back in the early '80s people were doing drawn animation so it would look like CG, since it was cheaper to do the drawn stuff and the 'glitz' of CG was 'in'. Go figure...

We see a lot of 'technology speak' that goes this way: 'photorealism' (to quote a friend and former Pixar colleague/photographer par excellence, Craig Good, "If you want photorealism, use a camera."), 'virtual reality' (virtual reality=theatre), now we're getting into this 'synthetic actor' thing. It is an interesting proposition but I can't really think of it as being really viable. As long as DeNiro or some lesser-paid actor is willing to sit in a chair for 12 hours having makeup applied we'll probably see humans, they're cheaper...

Of a little more interest is the strange practice of bringing people back from the dead. Kennedy in *Forrest Gump*, and the whole 'dead folks' Coke ad. I actually have a little bit of trouble with this. I guess I'm not too keen on the idea that

1000 years after my death I could be re-animated for a commercial like: "I'm not alive anymore, but if I *were* alive, I'd use BlatCo animation software!" complete with a talking, now dead, me. I wouldn't want my family to have to deal with that, even if they said, "OK, use his image, it's alright with us."

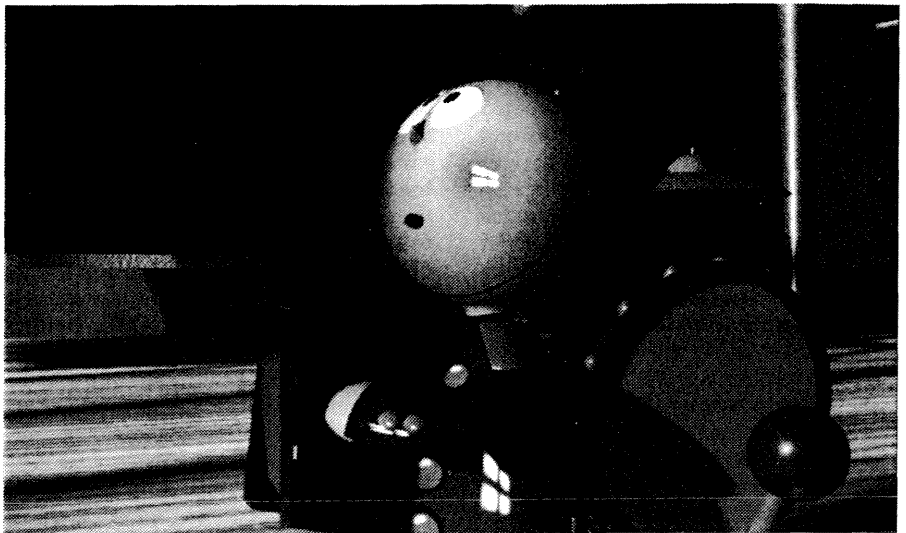
I need to remember to talk to my lawyer about getting that into my will.

I guess it's interesting now, but I doubt that we'll see much of it in the future. Faddish... now, the *technology* that went to making that stuff possible is really where the big win will come from. Computer graphics/animation is a little like that, we come up with a cool way to enhance satellite pictures so that we can drop bombs more accurately, and we apply it to cleaning up scratched old movie prints... My old mentor Chuck Csuri pointed out that, in the early days of the Computer Graphics Research Group, we had to take on government defence oriented grants so we could afford to make art. We'd always steal stuff from those projects, image processing for medical images became a way to make interesting painterly effects with cold sterile images...

As for where it's going, it'll probably go in split directions, the glitzy stuff will be around at a high price, just 'because it's CG' and the economical stuff will pay the bills. I think the Pixar film will get a lot of press for being all CG. I'll guess that the attention to that fact will be a bit misguided, since no doubt the story and *quality* of the animation will be so high. But people in general are really tied up in the 'toys' with an almost geek-like fascination. Hopefully people will see past the shine of the method and look at the product.

Are you guys working on anything right now?

FP: A little... like I said earlier, I'm currently doing my Ph.D. in cognitive psychology, doing vision research. Surprisingly, computer graphics and visual psychophysics have quite a bit in common. This has obviously come in handy. I'm also doing some aesthetics research as well. I have some fun systems that I have been trying to use to measure and model aesthetic preference. Fun stuff. It would be nice if it could be integrated into design software, perhaps to provide



Tin Toy's Tinny tries to decide whether to save his life or to comfort his nemesis. © 1988 Pixar

some type of assistance in exploring the rather substantial solution space of design problems.

I also have been doing a little work on

will not be able to until next year (after the film is actually released). However, I will guarantee that the computer graphics and computer animation community will absolutely flip over this film. Not

"Computer graphics/animation is a little like that, we come up with a cool way to enhance satellite pictures so that we can drop bombs more accurately, and we apply it to cleaning up scratched old movie prints..."

the side for Ion, a second generation spin-off from Pixar. We did the new David Bowie CD-ROM, along with Brian Eno's and the Residents. We're pushing hard to create the next generation of music album. CD-ROM is an interesting delivery medium. Right now it's rather platform-specific but new tools and emerging standards might change that in the future. I don't think it will go the way of the proprietary video game market.

TA: As you no doubt know, Pixar is currently producing the world's first fully computer-animated and computer-rendered full length motion picture. The title is *Toy Story*, and it stars the voices of Tom Hanks, Tim Allen and several other famous and familiar actors. It will be distributed by Walt Disney Pictures, and will be out for in time for Christmas. We cannot talk much about the details of how it is being produced, and we really

only are the images themselves totally beautiful, but the story is really exciting and funny. This is not gonna be a repeat of *Tron*. This is, of course, what Pixar specializes in: writing very compelling stories with real believable characters, and bringing them to life using the medium of computer graphics. ♦

A Selected Pixar Filmography

Highlights from Pixar's Short Cartoons

by Harry McCracken

The Adventures of Andre and Wally B. (1984)

Directed by Alvy Ray Smith. Scene design: William Reeves. Animation: John Lasseter.

The first Pixar cartoon—directed by computer graphics pioneer Alvy Ray Smith and animated by Lasseter—is the only one that is (at least eleven years down the road) more interesting as an experiment than as entertainment. The story is simple: a bee (Wally) and a bug-like little creature (Andre) engage in brief combat in a forest setting. The two critters are animated in a rubber-hose style that's reminiscent of 1930s Disney; while they're well done, they remain impressive pieces of computer graphics more than living creatures. One ends up admiring the technical accomplishments—the motion blur in the characters' movements and the realism of the forest—at least as much as the story and characters.

Luxo Jr. (1986)

Written and directed by John Lasseter. Technical director: William Reeves. Procedural animation: Eben Ostby.

The breakthrough. This tale of a playful child and cautious parent who happen to be desk lamps completely avoids the problems computer animation had been dealing with rather unsuccessfully until that point—the difficulties of modeling and putting into motion a human-like form, dealing with stretch and squash, and so forth. That two characters without heads, arms, or legs are expressive, instantly-identifiable personalities would be a remarkable accomplishment no matter what the medium this film was made in. (It has been remarked that *Luxo Jr.* might well have been done in stop-motion animation; given its utterly convincing photorealistic look, that might be true in a strictly economical sense. But the intent, of course, was to push the

computer graphics envelope, not to tell the story as cheaply as possible.)

Luxo Jr. remains Pixar's purest expression of what computer character animation can be and a film with undiminished ability to startle and delight both viewers new to computer graphics and those jaded by overexposure to them.

Red's Dream (1987)

Written and directed by John Lasseter. Technical direction: Eben Ostby, William Reeves, H.B. Siegel

This melancholy tale of a unicycle who dreams of circus stardom has a star even less minimally equipped by nature to be an actor than *Luxo Jr.*'s desk lamps, and yet who has at least as much personality. (You've never seen a human being juggle with as much feeling as the cycle puts into bouncing balls off his seat/head.) The film also features some of Pixar's most photorealistic rendering, particularly in the opening bicycle-shop scene, and the clown who figures in "Red's" dream is a (not-terribly-satisfying) precursor of *Tin Toy*'s baby.

If this cartoon has attracted relatively little attention among the Pixar cartoons, it's probably because it's a low-key, genuinely bittersweet film, and an impressive example of the Pixar artists' range.

Tin Toy (1988)

Directed and animated by John Lasseter. Technical direction: William Reeves, Eben Ostby. Additional animation: Reeves, Ostby, Craig Good.

The first (and, as of yet, only) Oscar-winning computer-animated cartoon stars a rather demonic baby and the wind-up one-man band who attempts, with mixed results, to entertain him. This is Lasseter's most elaborate film, and one of his most entertaining (though perhaps not as delightfully self-contained as some of the

others). While the baby is a terrific creation and one of the most believable human characters done in computer animation so far, the tin toy ("Tinny") is still a much more multi-dimensional character—his shy smile may be the most beguiling bit of animation in any of Lasseter's films.

Tin Toy's audio is as much a part of its success as the visuals: the use of sound effects creates a significant portion of the film's atmosphere. (There is no dialogue and not much music, and the film doesn't suffer for lack of either.)

Knickknack (1989)

Pixar animation production group: John Lasseter, Eben Ostby, Craig Good, Flip Phillips, Tony Apodaca, William Reeves, Ralph Guggenheim, Don Conway, Yael Milo, Deidre Warin.

Knickknack is Lasseter's cartooniest cartoon, a film which eschews strict photorealism in favor of a pastel look that goes well with the Bobby McFerrin soundtrack. The plot is a Tex Avery-like series of gags built around a little snowman's attempt to break free of his tacky paperweight home to join the other knickknacks residing on the other side of the shelf that holds them; the expression that covers the snowman's face before each attempt is worthy of Chuck Jones. Comparing the snowman to *Andre and Wally B.*'s Andre is indicative of the tremendous distance Lasseter and the other Pixar artists took their craft in just five years.

It takes a second, dispassionate viewing to appreciate the film's technical excellence, especially the physics at work as the snowman lumbers about in his water-filled dome, kicking up clouds of artificial snow. (The film exists in both a stereoscopic form and a more widely-seen two-dimensional format; the 3-D version is worth seeking out for its imaginative use of the form.)