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LEE HARRISON TAPE TRANSCRIPTION

Let's start from the beginning.

About Animac?

The concept of this figure itself, how you control it, the bones, the deconstruction of this image and construction of the motion.

I suppose you almost have to start with understanding the cathode ray tube display but normally you have a bottle that's been evacuated and there's a firehose of electrons at the very back of the bottle and they're squirted toward the front of the bottle where fireflies are arranged face in and when the water hits them in the face they glow for a few moments and wait till the next time the water hits them. That's a macroscopic view of what sort of happens microscopically. The beam is deflected around the face of the tube and when you do that you can draw pictures on the tube. We started out by developing what later became Animac. At first we called our machine "The Bone Generator" because it made sections of straight lines that could be hooked together and could be individually animated or moved in three dimensional space and to determine what a bone was you had to determine where it was to start in X, Y, Z space and in which direction it went from there and for how long in order to determine the length of this bone. The parameters that determined which direction it was going in also determined the actual length projected onto the face of the tube. If you saw a bone from the side you saw its full length but if it were pointing toward you, you saw only a portion of it. A bone was composed of a bi-stable multi-vibrator or a flip flop which the first bone in a series would get a pulse that started it and what we meant by starting it, it essentially put a signal on a line that governed the opening of a lot of gates, sampling gates and the inputs to the gates were the parameters that governed the position and some of the qualities and characteristics of that bone. To program it we had a patch panel that determined by going from one bone to the next bone to the next bone we determined the pattern or order in which the bones were drawn and we had a thing called the fly-back bone so that if we wanted to we could just go back to the mere starting place and we always, on our figures, had a navel point, we'd always flip back to the navel point, we'd go up and go out an arm and go back to the navel point, go up and go out another arm and back to the navel, go up and go out to the head. Those were all fly-back bones and we would fly back by just collapsing the information that was contained on a capacitor and I'll tell you about that as we get there. In order to determine the length of a bone we used time as the basis. We'd start drawing in a certain direction determined by the parameters of direction and we'd go in that direction until we'd turned that bone off and then essentially we'd wait there until we drew another bone from that point on or flew back depending on how we wanted to go or actually turn around and go back the other way on that same bone. We called those turn-around bones. The length was determined by plugging into a place where you could plug a timing circuit or a counter which was reset after each bone so when you started a bone you also started that counter and that flip flop was plugged into the counter and when it got up to the counter it would turn that bone off so it was pretty much all digital. That determined the length of the bone. The next bone would be plugged into another count and so forth and you varied the counts depending. A count represented some number of high frequency units that was part of the clock network of the whole machine. Anyway, while the bone was turned on we had all these gates that were open and the gates would have such values as . . . to say DC values determining the starting point, X Y Z of that bone if it were a beginning bone or a base bone or a navel point because if you moved that point you move every bone in the whole thing, so everything hung together because one bone took up after the next bone.

Could you describe the patch panel again?

The patch panel was color-coded and it was a big patch panel we got out of the junk yard someplace 'cause nobody used that stuff anymore. If you understood the code you could actually see the bones on this patch panel and there was some overhead on each bone. I suppose you'd call it overhead but there were places where you'd say, okay, here's an input to the bone and that would be a certain color like a green or something and the output might be a blue. Well, if you were going to bone number one, you brought a start pulse that was located somewhere on that panel and you'd plug from the start pulse to the first bone and then you plug from the output of the first bone into the second bone and so forth. Each one of those had a upper part to it, I say upper part, I mean generally the things that governed the structure of whatever it was we were drawing. We were near the top of the bone and then I guess that's all . . . oh, we had ways of determining whether that was a turn-around bone or a flyback bone or after the drawing of a bone you would fly back and things like that. They were little coded things and there were little patches, I mean you would patch close into itself. It was kind of a control for each one of those bones. The inputs to the parameter gates were not located on that panel. They were located down a little lower on the face of the Animac and there were hundreds of those suckers, just hundreds. Because if you had thirty bones, we had thirty bones on that first Animac or the first solid state Animac, there must have been ten or fifteen parameters for each one of those so it seemed like an overpowering kind of thing but there were a lot of things you wanted to do with each bone. Remember now, we've determined how the parameters are organized, sort of a control structure if you will . . .

A hierarchy?

The hierarchy of the bones. That's right, how the hierarchy is determined. We had a parameter called Theta which controlled the angle of the projection of the bone on the X Z plane and the X axis, that was theta and the angle of the bone between the Y axis and the bone was called fi. So with theta and fi we could point the bone in any direction. Those inputs, theta and fi, start out being potentiometer inputs, DC essentially, that would change slowly with time, meaning there might be a slight change every thirtieth of a second or every 24th of a second or whatever depending on the frame rate. Let's take the value of theta, theta was some value of voltage that represented some angle between 0 and 360 degrees and it was a DC value that existed over the same period of time that existed the length of the bone. This DC value went down a wire to a sine/cosine generator and there we took the sine of the angle and the cosine of the angle by a keen little trick. We had this all coordinated with a high frequency sine wave and cosine wave that were located in the proper phase angle to one another so that one is the sine and one is the cosine. We had a sample and hold circuit that would be controlled, where it sampled the sine wave and the cosine wave was where theta was. So it would sample that and hold that and then sample it again so over a period of time we might sample 20 or 30 or 40 times per bone and put that in a big capacitor and make that appear as a DC value that represented the sine or the cosine of the angle theta. That value then was presented to an integrator. Now the slope of that coming out of there was proportional to the sine or cosine of the angle and by applying that to the X or Y axis of the oscilloscope you got the thing going at the appropriate angle on the oscilloscope. Now actually it was a little more complex than that because when you're going in three dimensions you have products of the sine of alpha and the cosine of beta times each other. And because the multipliers weren't very good we used . . . you may recall from your trigonometry, the sine of alpha plus beta equals sine alpha/cosine beta plus or minus the cosine beta/sine alpha and so forth. You had components that were the results of multiplication and we'd take and add these together and have two times the value we wanted and divide that by two and now we had, without any multiplication, we had actually multiplied the sine of theta and the cosine of fi, the sine of fi and the cosine of theta and so forth and all the combinations just with addition which was easy to add and hard to multiply. So we got very accurate and nice things that gave us this 3 dimensional capability. Well, you can see as this DC value that represented the right value such that if it went into an integrator it came out here as a ramp and the X integrator and there was a Y integrator . . . actually there was Z integrator too but let's not get too complex here. This came out with a ramp and on the oscilloscope what you saw was something that went at the angle theta as desired when these were applied to this. Actually we went from here into . . . we had a Z integrator. These were applied to great big sine/cosine potentiometers pots--again a method of multiplication without multiplying and so there were some sums (?) and additions and what this was . . . big horizontal and big vertical and these now went to the horizontal and vertical plates of the oscilloscope axis. So when we turned this knob, this was like a camera angle network, that's what we called it. It was like changing the camera relative to all these things. These individual inputs out here in the gates, these gates were all attached, they were all driven by the same flip flop that was at the head of each bone. The gates would open and we'd put theta and fi and R, what's that, well, we didn't only just make a bone and go from here to here, we added a high frequency component that was spinning around like that and R was this distance, the radius of the spin and that gave you volume. So we called that the volumetric network that would multiply this end and the patents show all these components. If you understand this much then you have a formula for X, a formula for Y, a formula for Z and a formula for horizontal and for vertical. This has some K T, where this is the ramp part of it and plus there's a sine omega ti and a cosine omega ti component and that's this (sketching), the spinning vector. Okay, now let's take a little object. Suppose I wanted to draw a vase, immediately it comes to mind that a bone goes there and that this R now is a function of time that looks like this. This is R, this is time. So the vertical axis has the length of this changing shaped vase but now if at the same time I put a video camera here like this and put a piece of paper under here like this and let's suppose I paint a flower like that and this is scanning like this or whatever and while this is drawing like this, suppose I use this information to modify the intensity and then I can get a flower that's put on there like that and this we call our surface characteristics and the idea was to keep going until we might be able to animate with the quality of a Rembrandt. Still goin' to do that.

Are we missing something that's essential for this whole process because in this explanation I found encoded the whole futuristic development of your machine. Is there any substantial part to this what you have said . . ?

Oh, I know what I didn't talk about. You have all these hundreds of inputs required to make the thing happen and to change it over time was the thrust . . . after this, the main thrust of our development was to make things change over time which eventually culminated in what we called key frame programming where we would turn knobs until we got a character of whatever in the position we wanted and the color we wanted and everything we wanted and then we recorded instances of all these parameters and then we'd say at some later time the character's going to be in this position, another key frame, key frame number two and we recorded the instances that put it in that position and then we could automatically go from the first set of instances to the second set of instances taking as many frames as we wished. Not only that, we could shape the velocity curves by, for example, if you had some value to start with and some value to end with, we could go straight, called straight line programming or we could go slow out, slow in or we could go slow out and fast in. We could go anyway we wanted so that the parameter changes were divided up on frames so there'd be accelerations and decelerations and things like that and sometimes we had a thing to make it as smooth as possible and sometimes we could use sines or splines or any kind of a mathematical function that you wanted. That made for some very nice animation but we didn't change this a whole lot. Now this has an equivalence, all this kind of thinking and when I say all this kind of thinking I mean, Look, I can point here and I can say oh yeah, if I put something there this is going to happen, if I put something there this is going to happen to this bone or this is going to happen to that bone. Well, if you take all this and put it together you get into a mathematics of vectors and matrices. Well, that's fine for the mathematician but you get . . . in a matrix you get down here and you have a whole bunch of equations and relationships and you get something down here and it's a combination, it's a small part of this input and a small part of that input. It's combined mathematically so you have fewer components in your machine that have to worry about that. You don't have to make multiplications twice or three times but it destroys something from the artist's standpoint because he can't, in his mind, say, oh if change that a little bit, unless he becomes a mathematician but then he doesn't know when he's changing this parameter if he's simultaneously changing this one or this one. So you lose the direct one on one kind of pointing that I think an artist thinks. An artist doesn't think in terms of matrices.

Yes, this is the problem with digital 3-D programs, they give you a rigid perspective and you can't tweak the relationships as you describe them.

Well, we finally got into that. We had the rigid perspectives but we could actually change perspectives too. You could say I don't like this camera angle. I want a wider angle or a narrower angle and but you know I think the art begins to lose something in that arena right there. It's starting to change. It's more assistance than you want because in order to be assisted that way like maybe a simpler architecture or something, maybe it is simpler to the mathematician or whatever but I don't think it's simpler to the artist because you can't put your finger on the exact place that you want to put something in order to do something. There's no smell left. There's no muddiness left, there's no dirt, there's no eraser, there's no glue.

Is what you're saying that you purposely introduced levels of redundancy in control?

No, I didn't purposely do that that when we were doing this. It just seemed so logical to lay it out this way because you could say Danny (?) if you want to do something you do it right there.

The result was . . .

. . . always the same. If you wanted 3 dimensional stuff I have a very simple methodology that uses a divider and couple of things for producing automatic perspective. This did not produce automatic perspective so that if a bone went away from you . . . I haven't shown here that when a bone goes away from you, it gets smaller or larger.. . when we started out the character was always within the depth of field or whatever and the cues for 3 dimensions were dynamic, the kinetic depth cues. Oh, it sure as hell looked 3 dimensional. You could tell when it was turning around but it took a separate network to give it an automatic . . .well the spaceship. . see, a lot of stuff we would just animate because it looked good, looked right. We'd organize things so it looked right. Essentially, we were pumping in our own perspective. But we did have a patent on an applied automatic perspective which later when we got into more digital technology and brought in more mathematical assistance and essentially for the programmers, to tell the programmers what to do, they went into matrices. It was all automatic and you say you want 3-D and you got 3-D but again you lost something. It was more of an abstraction but that's just my point of view. I could always and see and understand the guts. I understand the guts of the digital computer very well but they don't expect you to be able to do that so when they teach you a language that's a whole bunch of different shit. It's disjointed from that. And if I'm going to understand it I've got know and I will eventually know that here's what you're really doing when you're putting this header on and laying out these variables ahead of time and describing them and all that. You're just making room for all that shit someplace in the machine. That's okay. That's alright but they don't have to tell me this . . . as long as it's got a good reason then I don't think I'll be so forgetful and not put the things on there.

I think we've got this now. Could we jump into a little history? What we are into really is tracking down certain reasons why . . . or was it you who suggested a machine to do the drawings?

Yeah, that happened. I was down in Guatemala and I was painting an 80 foot mural like I told you in Pecos Bill's Texas Embassy, a hamburger joint. 35 portraits. I had a friend who wanted to be a writer and he thought that if we just went somewhere, like to hear the mission bells in the Andes. He says it's just them dumb llamas down there listening to it. We ought to go down there and hear that stuff. I said that's not a bad idea. What else better to do? We had a jeep and we painted monitor NBC, that was a popular radio program at the time and we wrote letters to Dave Garroway and some of the other folks and David Brinkley and said what we doing and told everybody we were from Monitor NBC, New York City and we'd drive right in and we actually drove into the bull ring and got kicked out at gun point down in Mexico City trying to record a bullfight. We interviewed Patty McCormack, the first woman bullfighter and we got into a lot of things and did a lot of things that we wouldn't have otherwise done. We kinda felt like that was our job, you see, even though we had no official connection whatsoever. I don't think any of our tapes ever got back to Monitor NBC. People would be afraid. I'd say would you just stick this under your seat and take it over the border and mail it in Texas and here's some money and I don't know whether they ever did that but it didn't matter. It gave us a raison d'etre to get up in the morning. When we got to Guatemala after I got very sick I thought I'd get kicked off the train in the middle of the jungle for a string of reasons but like I didn't have a ticket but that's another story . . . (it sure is).

Video stuff resumes here

I had signed up as a mechanical engineer cause I was afraid of electricity and I didn't know anything about it. But as a freshman you have to take various classes and I met an oscilloscope and I said Hey wait a minute. I always loved animation. Somehow there was a click and I said this is the way it will be done. I was on the GI bill and I went down to the Veteran's office and I said I'd like to switch schools from mechanical to electrical and they said I couldn't so I went to my teachers and told them what I was trying to do and they actually gave me a class where I was the only student, I could do whatever I wanted to do, I just had to write a final report and so I finished engineering school in a little over two and a half years, very intensive and all that but I was turned on. Every time I turned a page I would just sop it up. I just loved engineering and math. I'd done well in math and all the sciences in high school. Then in my senior year I read a paper on fake color by Bill Altimus who worked for the Philco Corporation. This was early 1959 just about the time we all started to interview for those graduating in 1959. It may have even been late '58. But there was some people from Philco coming through there and they represented both Philco Research which was government supported and well supported then in 1959 and also the civilian side, the refrigerators and things like that and also I had just received my first patent. It was for a ball and socket joint that was a peculiar kind of a thing for strengthening ankles and stuff.

Prosthesis?

It was a platform that would go around when you stood on it. But it went the wrong way. And I got to know these patent attorneys in St. Louis who by the way were introduced to me by Don Fisher who was also a patent attorney. He's actually a specialist. He was an expert witness in patent cases.

You went to Philco to work?

I got a job with Philco and I got one in the same laboratory as Bill Altimus. My first day there I went to see him and I said I've been wanting to meet you for a long time. He was kind of an engineering type, quiet, competent. I began recruiting him that very first day and it took me till about Christmas time. I went there on June the first and it took me till about Christmas time to assemble my group.

What was the project?

Our nighttime project was animation and I started by building a bench and my father-in-law was an investment banker and anyhow we formed this company where everybody paid to work and if you had one percent of the company you paid five dollars a month.

Meanwhile you worked at Philco?

Oh, yeah. We did this at night and on weekends.

What was the name of the company?

Lee Harrison & Associates. We had an articles of agreement and if you came in you had to catch up so everybody was in on the same . . . if we disbanded we'd divide whatever was left. If you wanted to get out you could get all your money back if it was available but you couldn't take anything you'd done and anything you'd contributed from a mental or physical standpoint remained. The expenditure of money was governed by . . . you had to be able to hold it in your hand otherwise you paid for it yourself. You couldn't take anybody to lunch. You couldn't pay for a lawyer. It had to be wire or tubes or something that was physical in nature. Guys came in and guys went out on different levels but one time we had 13 guys including the patent attorneys in St. Louis who were also paying to work and when I told them it was five dollars a month for 1 percent . . . Mr. Rogers, who was president of the American Patent Attorneys Association so it was no flaky firm this. Probably the only time they'd done it and probably sorry they did. His daughter was going through the school of fine arts in Washington University as I had when I told him about this thing. He said "Well I don't fully understand but okay I think it's an interesting thing and we'll go along with it. How much do you want me to have?" I said, "Mr. Rogers, you're in a position to demand any amount you want because we know how vital it's going to be to have patents and we believe in patents but if you want control or something like that it makes it difficult to form a company, to get the other kinds of talent involved that are going to be necessary to make this successful. It's a terrible responsibility if you want that kind of control." And he said, "Well, what do you have in mind for me?" I said, "Well, I thought we'd start you at 3 percent and if you do a good job you could get up to five." He looked at me. I said, "But then we have plenty to work with." He said, "I'll do it on one basis, that you are personally always in control. Or have the most shares." I said, "I'll do that. I'll promise that but if I get to a point where we can't have it that way anymore I've got to be able to ask you to reconsider." He agreed. I said, "I'll promise I'll come to you if that's ever a problem." So he signed up. I told him we didn't have any money and everybody who's an owner has to pay 5 dollars per percent per month and he looked at me and said, "You mean I have to pay to work." I said, "Just like the rest of us but I swear to you everyone else is in the same position." And I said, "You've got guys working there on the engineering side that five dollars a month for a guy starting a family, starting out in his career, that's a lot of money to him. It's not frivolous to him." I said, "Our key guys have five percent and they're paying $25 a month and that to them in some instances could have been their Christmas or something like that." I said, "I'm glad to show you any of these things. I'm not lying to you." And I wasn't. I said, "You've just put me in a terrible position because here I am in the same position but fortunately my wife's working and I'll be able to make it out," but I had to borrow money from everybody I knew. My brother and all those people. It worked very well. We never had a stitch of problems. We never had a disgruntled person. People got in and out just like it said and they got all there money back and Freddy Massino was one of the very loyal guys. He was in Philco also and they were moving his division to California and he came to me and he says, "Pops, could I not take my money out. Just treat me however you want but I'd still like to be a part of it if I could." When we went public, one time I was out there and he asked me to come down to Anaheim or Costa Mesa and he says, "Pops, get in the car I want to show you something." Took me down and showed me a great big sailboat that he had bought with some of this stock and he said, "I want to thank you." We kept him on the books and he didn't take any money out and it wasn't very much. It was only about $150 dollars.

When we started we converted our ownership at ten cents but you see ten cents. Christ you may have put in 10 cents but you may have put in thousands of hours of work.

What did you do during the day for Philco? What was the project?

At first I worked in the research laboratory. I worked on various projects. Some of them sort of mathematical but one of the things I liked doing and had the most fun doing was developing a bench methodology for testing reticals. (?) for sidewinder missiles. You just have a detector there and you chop it a certain way and depending on the shape of the way you chop it, it'll distinguish between cloud edges and tail pipes and things like that and I'd make these up, do the drawing, I'd photograph it on Kodalithic film, I'd develop it in the lab and I come out and cut up my reticals and I'd put them in there and then I'd take measurements with a frequency analyzer, Fourier type analyzer and I learned a lot and it was all mine.

There was a project called Sage. Do you recall that?

No I didn't work on that.

What was that?

I don't know.

It was a kind of a display. Military stuff.

They had a secret there at that time called the "Apple." That was their code name for a better color television than the one that RCA had but you see what RCA did . . . General Sarnoff went down on the line and he said, "Get those color sets out there and I don't give a damn if you have to send a technician to every house that's got one but do it." So then he went to Washington and he said, "Hey, we got people out there, we got voters out there who've got these sets."

He was a bastard, wasn't he?

Oh God, he was a tough son of a gun.

How did you separate from the company?

Well, the first time I left because my patent attorneys wanted me to get a clarification from Philco. When I signed up with Philco it said if you have any prior inventions just mention them in this space and if you need more just turn it over. One of the things that Bill had worked on was a thing called the Philco Exicon. It was a method of colorizing X-Ray film and to separate levels and so forth. So Bill was the greatest electro-optical engineer in the world I think.

Still alive?

Oh, yeah. I saw him just the other day. Matter of fact, he just fixed my TV set. I've got what used to be a very expensive computer upstairs and I'm going to use that to practice my C and C plus plus and some of those other things.

How did he quantify, he analyzed it and made a sliced image or was it . . . discrete?

In other words he'd take some density that was equal to some color and he'd have a density distribution and he did like that. What I wrote on here because our requirements . . . I just said that

. . . see I learned a lot about video in studying. I told him in very obtuse terms that . . . I was afraid to say the words electronic animation because everybody would say, "God, what a great idea and they'd all want to do it." Years later when I was trying to explain what we were doing to the investors they'd say "Gee. I don't understand that." I'd say, "Look we got these bones, and this." And I couldn't make anybody understand. Very paranoid. You know, inventors always are. I went on my lunch hour to the administration at Philco and I said I wanted to see a copy of my application and make a copy of it. And actually they were so blase I could have walked away with that piece of paper and they'd never know but I wrote down what I'd said on the back. It included improvements to the Philco Exicon. Well, that's like waving a red flag in front of a bull and apparently they had never read this when I signed up. This alerted somebody and before you know it they were saying, "We want you to sign a new agreement and postdate it to June 30, 1959." And I said, "Your ass. You can't do that. That's not fair. I've been operating for two years here." And they started to pressure but I played Brer Rabbit. There was no goddamn way I was going to sign that thing but they thought they had me. I had just gotten married and had a kid. Didn't have any employment other than Philco and so I left. The guys in the research labs . . . I knew him all. I was a great . . . I knew and respected them and I'd say, "You're the only guy in the world that knows how to do to this. Could you help with this?" They were friendly to me 'cause most guys were trying to say, "Well, that's my idea and . . " I had one great boss. First time I got a project from him he came over to me and he had a little folder and a piece of paper and he said, "Pops, you remember when we were talking the other day in the lunch room and you had this fantastic idea of doing this and this and this." I said, "Bob, goddamn it, that was your idea." And he said, "Oh, no, no, that was your idea and you're the best guy to carry it out." I learned a lesson from that 'cause years later when I remember I used to have so much time because for a lot of that time I wasn't working. When I left it was almost two years before I got rehired. I applied for patents and I could do whatever I wanted to do.

Do you think that Bill Altimus still has the paper on false color. What was the paper called that you read in school? Do you still have it in your archives?

No.

Do you think it was the first study of this false color that's related to television or was it television?

They were trying to colorize x-rays to see if they were better but I don't thing anything happened to it. It was called a Philco Exicon. It was probably a color television set of their own design . . .

Do you think it was the first attempt to do this?

I don't know. It was just by chance that I came across this but I wanted that guy to work for us.

What year was this?

1959. We had a pre-Christmas party at my little apartment in Bluebell, Pennsylvania and Mary Lou and I had a bottle of champagne left over from the wedding in June and I'd made some drinks for everyone. Bill is really not a drinker at home but he gets out and he loves to have a little drink and his wife Ginny was there, Freddy and his wife and so forth. I was like an evangelist and I told about how important it was that mankind (and I really believe this) have a means of expressing themselves that moving and dynamic so that he can understand the dynamics of the world, that we're still kind of locked into the flatness of pages and the concrete of text and that we needed something that would portray things more the way they were and therefore with more realism and easier understanding and that I thought that the trends in animation from Disney and all those great guys and that the costs were getting higher and higher and that talent was getting more and more overseas and weaker and weaker here. The trend was that something had to be done and I said there's a guy from MIT, and they're supposed to know everything, who says you'll never animate a character with a computer unless it's bigger than the Empire State Building. His name was Sutherland and he writes a lot of stuff and he's an important guy and my father-in-law pointed this out that how come we're so smart and to get all these guys in the beginning I said, "Look, I can't tell you what it is unless you'll sign this piece of paper. It's a secret." I got everyone of them to do that and I had to do it just with an intensity, a reflection of seriousness and love of life and a few other things and we got to be friends. They were sitting there and I gave a glass to each one and I poured out the Champagne and I said, "Anybody who's not with us at Lee Harrison Associates, please don't drink." I said "Here's to the company," and everybody drank and I knew Bill wouldn't put down his champagne.

Tell me, did you already know when you had this conviction, was it already on your mind?

Yes, this was in process.

Already but this was your religion basically.

Bill taught me about electronics. I didn't really know very much about electronics and he taught me about these things and at one time the closest I came to designing a circuit was in the sine/cosine generation area. I had learned enough about it so that I could say here's the layout of the circuit. This is the way it ought to work and also in some of the mathematical relationships but Bill contributed a lot. It was a fairly mutual effort because he could teach me a little bit and I could run with it for a long time.

Could you give us the stages and names of this machine or systems as they progressed?

Well, there was the Bone Generator and that had four or eight bones. I think it had eight bones and that was just a piece of aluminum mounted on a board and that was the first one. The second one had 16 bones I think and a big power supply underneath it and there was a wooden rack and I've shown you pictures of that. I've got some pictures.

Was it still sticks or did you already have the fast vector to draw the flesh, I mean the body of it? Even the first one already had the sticks, the bones and you could also modulate . . .

And the skin. Some of it we did in a phony way in the sense that we didn't have multipliers that would keep up with it but we could set resistors and show no bone and then skin.

What do we call it? Spin bones. From day one you already had a bone which could have been made into a volume so to speak and what was name of the second generation?

We still called that the Bone Generator. We called it that until somebody said we ought to have a name for it and I came up with name Animac which meant animation big and Scanamate. Dave Wells thought of C.A.E.S.A.R. that's "Computer Animated Episode Single Axis Rotations." Dave Wells was an engineer.

Who was that?

Dave Wells.

And he came up with the term CAESAR. Which stands for?

Computer Animated Episode Single Axis Rotations. That's the way I remember how to spell

CAESAR. I'm terrible at spelling.

Could you give us the dates. Let's see the first bone . . .

I don't think we named it Animac until '67 or '68.

What was the date of the first bone generator?

Very first was late '59. Between Christmas and New Years we had our bones working. I had multi-axis joysticks that I'd built with . . .

But this update from 8 to 16 bones, that came the year after that?

Yeah. 1960 we had that and we kept working on that until 1964 or '65. It was in Bill's basement and we would use that for demonstrations of various kinds. I did some filming with that and we made some films. We had a guy named Dick DeFrenes who was part of Lee Harrison Associates who I think bought most of his home with stock that he . . .

What's his name again?

Dick DeFrenes.

And what was his function?

His father had the DeFrenes Studios in Philadelphia and I went to meet him and he was the son of this guy and he was an animation cameraman.

Where was the basement studio located? Was it in Philadelphia?

In northwest Philadelphia. When it was in my place it was in Bluebell and there was a city right next to it where Bill was . . .Ambling? Just down the turnpike.

Suburbs of Philadelphia?

Suburbs. Right. Then we moved to house in Norristown, PA.

What system were you working on then?

Same one.

Still bone generator. Still the same name?

Yeah, but we began to build things that made it easier to turn knobs and we had two racks and it began to expand.

So when did you put that name . . .

So we put that in a sunroom and pulled all the shades down and in the cold winters that's not too far from Valley Forge--cold winters. Remember your history. And my wife and I would turn on that machine to heat up the house. Mary Lou was really magnificent. She would make cookies and ice cream for the guys. Years later she told me two things. She said, "You know, it really used to get me angry 'cause you'd lie down in the day time and you'd look up at the ceiling and everything and tell me you were thinking about things but I thought you were just a lazy SOB. I want to tell you

I'm really sorry I felt that way." And the other thing was she determined that there wasn't any way that she could compete with that machine so all she did was help. And she did. She was totally helpful. When I finally went back to work was when we lived in this crazy man's house and he used to come out and sleep under the porch and do all this weird stuff but the rent was cheap and it was okay and the backyard was filled with dandelions and my wife came in and she'd been picking dandelions and she said, "Don't you realize how good they are? Dandelion greens are very good for you. A lot of Vitamin C and everything." And I thought, "Oh, shit I've pushed the system too far when I've got my family eating weeds out of the backyard." That's going too far. So then I got back to work at Philco and I worked as a bio-cybernetics and I developed a patch for taking electro-miographic signals and also worked on some programs for prosthetic control and things like that and used to give papers. My brother, the doctor, was helpful in some of the thoughts.

So when did it become Animac?

1967.

And then?

And there was we did was we translated from tubes to solid state. When Francis Honey started that in his basement.

Francis Honey. He was one of your engineers?

Yeah. He was one of the first guys here in Denver.

You moved to Denver?

Moved to Denver to the Denver Research Institute.

When was that?

I started here in 1965 and I told the guy, the guy I met, Karl Hedberg, he was head of the electronics division.

Of what?

Of the Denver Research Institute. He'd been one of the founding guys in that institute and he was a very, very nice man.

What was the Denver Research Institute?

University of Denver.

What type of research?

Jeez, they did everything. They survived mainly on government contracts. One of the main things they did in the electronics division . . . they had an EMP division. They built some very fast detectors, things that would happen in the sky, nobody really knew what they were really doing. But they had Tykeman and Francis Honey and all those guys came out of that lab so they were very good engineers and the guy that was running the lab at that time just chewed me out and said, "You son of a bitch, you sent those guys back here." I said, "Are you kidding? You can fire'em and I'll hire'em back."

You had all these talented people. What was the name of your company?

Then we called it Control Image Corporation and it was about that time that I met Paul Raibourne. Paul Raibourne was the inventor the Trinitron tube and he was senior vice president of Paramount Pictures. They sold Trinitron to the Japanese. I named my son after him. Paul Raibourne was a genius. I didn't know he all these inventions to his credit but he made his bones in Paramount when he fought the anti-trust suit brought on from all the famous actors, Douglas Fairbanks, Jr. and that whole crowd of very famous people who said that Paramount just made them do what they wanted to do and he said they're artists who wanted to have no control and it went all the way to the Supreme Court and he won. Just a bright man and tough and mean. We wanted him to sign a secrecy agreement and he stormed out. We didn't know what to do. Anyway, there are some early books on television that if you open the flyleaf you see the National Television Standards Committee (NTSC) and who you got there? Well, you got a guy named Don Fink, a guy named Vladimir Zworkin, a guy named Sarnoff, a guy named Dumont and right in the middle is Paul Raibourne and he told the story of how he got NBC interested in television and what he finally did . . . oh he had a television aerial in 1934 . . . and he was there when they broadcast the first television from Washington, turning on the Christmas tree in Washington D.C. to New York. That was the first broadcast. It made him a very patient man. Often we'd get ready to demonstrate something and something would be screwed up and he'd say "Oh Jesus. Let me tell you, the President was there and everybody was there and nothing happened and somebody had kicked the plug out so I know all about that."

What was the machine you used here? You said it was the first illustrator machine when you moved here? And we called this Animac? When did it become Scanamate?

Scanamate was sort of a subset of this in a sense. I think we had five sections. We didn't have an unlimited number of bones because it was all hardware. We had five sections. There was a sequence of those that were always the same, you know, first, second . . . no I think we might have even been able to change that but we always started from the top and went to the bottom and the things we wanted to show over or whatever we just order the art work that way and what we did with Scanamate, it was the beginning of an attempt to provide slow frame by frame changes of many parameters over time in a smooth fashion. So we had start/finish, start/finish and you'd put something here and it would go whoomp! and then we had an animation aid so we could go start/finish, start/finish, start/finish, five times on five different bones. So you were starting to get sequences here.

When did you unveil that Scanamate? When was it officially running?

The first breadboard of it was actually on that machine. We brought up some integrators and you could get ramps out of integrators. We brought up some sine wave generators . . .

So there's no dramatic moment at which it became Scanamate?

I guess as soon as we demonstrated it there we just made a box just for that. And then you'll see a thing called "A New Way to See" with Ed Tykeman demonstrating some of the things and Maron Smith was the cinematographer on that.

It was one of a kind. There were no two?

Well, the one after that became a large model and had all the kinda stuff that you'd expect to have in a professional model.

And that's when it got distributed into the cities of the USA.

We had one here and then we had two here and we acquired New York and we built two for New York and we had one in L.A. One here and then we sold one to Levitz Furniture Company.

Levitz Furniture Company?

Cause they were going to do their own commercials. And we could control what they did. They weren't going to enter into a competitive situation with us and then we sold one to Japan.

What years are we talking about?

Early '70s.

Now when did it become CAESAR?

About '70 we started to develop what we called a digitally controlled machine and this was processing was always analog. There's a good patent called the CAESAR patent but here again it was an exercise in control and that's where we introduced key frame programming.

So you basically made this very intelligent front end.

But the visual data handling portion of it remained the same and that was our downfall. I have designs for a solid state scan converter and could have hooked right on in some point in here.

A buffer? What would that be?

That was a weird thing. Here's a way you can imagine it. I had a matrix of multipliers. Now what I'm going to tell you is a way to think about it. It's not the exact process. If you think of plugging into the first piece of color. Here's a video image and you plug into that and you're going to put it somewhere on the output plane and you've got a matrix of multipliers, maybe like that (sketching)

These are dedicated.

M1, M2, M3 and on one side of it is the intensity coming in from the . . . it's the color. Now it's three times this . . . one for each color or whatever but and you think of an output plane as being . . . see how did I do this? One, two, three. This would fit over there and it would move . . . the numbering of this was the same as this but it didn't matter if the repetition. This was the method for interleaving the output memory. It was interleaved. So this gave you additional time to access. Is there anything there? If there is, does that go on top of what I'm putting in or so forth? And the movement of this was driven by this output here. We already had this coming out in 12 bit form at video rates and we moved this around and I had a thing called the "long word" which determined what the waiting functions were for each one of these depending on where you were located within one of these squares.

You are right. There was a buffer, there was a memory representation. You were simply addressing it and scanning . . .

The waiting of how much of this (?) goes into each one. So you didn't get jaggies and things like that. I couldn't get the guys to build it. They were . . .

Do you have the sketches of it? Do you have the block diagramming of this somewhere? Any conceptual work?

I think I do somewhere but I don't know why you'd want that.

Just because it's an original bridge between the analog and the digital.

It was sort of digitizing an analog function.

Yes, it shows an interesting transition way of thinking about it. You would eventually end with a full-fledged computer as you are thinking about now. You must have given up. What was the reason? Was it a financial reason?

Sure. I would go to Ed and Ed was our vice president of engineering and I'd say, "Ed, why don't you build this?" He said, "Lee, tell me what a 'long word' is?" I said, "Well, I don't know what a 'long word' is but anybody who'll sit down and say look there are nine positions within a pixel that this center one can get and if you're here, you want to put so much of the energy in here, so much in there and so much in these surrounding pixels. So you've got a word that . . . so where are you in terms of the grand scheme of things and then where are these relative to this and actually the interleaving that was done provided sufficient time to do what needed to be done in real time.

What we are talking about is actually a real time system because you couldn't give up this because that was a real time alteration. Computers didn't have and still don't have . . .

But it's limited you see. If you want to think of it in terms of real time instead what we can do is draw eleven hundred and twenty lines in a thirtieth of a second. Now whatever that image is, if you need more than that you do multiple pass, you do another pass, you do some other part of the image that's going on at that time. "Custer's Last Stand" was twenty passes. Did you see it?

The film? I think I did.

Well, there's a thing called "Custer's Last Stand." It was for the Navy. Twenty passes. If you have the kind of speed that gives you an inordinate amount of time for every pixel under every kind of circumstance, if you're going to make a movie and expose 70mm film you got to have a lot of pixels every frame, and maybe under those circumstances since we all don't have 70mm projectors in our backyards it doesn't matter whether you go in real time if you're just exposing that film but I believe for the process to come full circle in the development of the artistic process that the artist has to ultimately be able to have the feelings that are necessary for an artist to have during the process of creation. Now animators, great animators are really magnificent cats. They can sit down and make a few sketches and they understand the action but they deal in miniscule pieces. It's still took a Walt Disney to say "Hey, no, they're not going to cry if they see it that way, they're going to be frightened if they see it this way." I mean, show the huntsman's shadow come across her back. That was the drama of Snow White. Well, the animator's who graduate from a board and get to be directors and get to be story guys and so forth, they're on a different plane. So it's a group activity and it's marvelous that a thing comes out the way it does.

Tell me, you said that you couldn't really convey anymore to your engineer the reason why he should build this.

Oh, no, no. Ed would say, "Lee, look I'll do it but I need a budget." In other words, he was always the treasurer and he was on the board and what are we going to do about this bill and that bill.

So it became that crisis when you were not free to be able to put enough money . . .

It happened very quickly. In '72 technically we were bankrupt. We had a negative net worth because of a change in an accounting procedure. In other words, it used to be if you did some research, here's your balance sheet, here's your assets, here's your liabilities. They have to equal one another. This is what you have and this is how you owe it. Down here are the shareholders. They own a certain amount. You have debtors and so forth. This side just tells you who owns it. The bank, you may be paying off something to the bank. You may be paying so much a month in rent, things like that. This is what you have. You have your cash and you have receivables and various things that get harder and harder . . . now here you have land or something like that. The most volatile things are at the top and the least volatile things are at the bottom and its equal equal. You may be never heard that explanation but that's a good explanation of a balance sheet. Now when we had a negative net worth it meant that we owed more up here than we had down here. If we took cash and we paid salaries and stuff like that and we did research supposedly you have something when you're through, ideas or methods or something and we would carry this on our books as an asset. Now when we became a public company there was a change in accounting procedure for public companies. The idea being what's best for the shareholders and what's conservative. Now for General Motors it was better for their shareholders to wipe this out. It really didn't make much difference to them. Their ownership was based on something entirely different. How much cash they were generating . . .

How many CAESARS did you build?

One. Anyway when this was wiped out it put us in the negative net worth position.

Where is the CAESAR?

I think it's in Washington, D.C.

Owned by who?

There was a company there that . . . when we sold our production division. the final liquidation was in '84 or '85, to a company that we sorta helped start and they went public to raise the money to pay us which went right to the bank. We sold a Scanamate and a CAESAR and a System 4 to them. But they set up operation here and they were known as Computer Image Productions Inc. They had another name, Kinetic Design Systems and they went bankrupt very shortly after this. We still had some notes. This was given back to us but it was all in the bank's hands and they sold it off for practically nothing.

What is System 4?

System 4 is a total, well, except for this process, except for the video data handling it was pretty much the same but everything else was totally digital.

Was it built?

Oh yes.

How many?

Five I think. Let's see. Luxembourg was two, Mexico--three, four in Santiago, one we did in a partnership with Editone out in California.

So that's the only one in the U.S.?

We still owned it. We were in partnership. There were two here. One in Denver and one in Los Angeles.

Is it still running?

The one in Denver went with a group that went bankrupt and that one is in Washington DC.

Which one is in your warehouse?

The best one that we ever made. That was the one that came back from Los Angeles.

What was the name of the model no.?

System 4-5.

And that exists here in Denver?

Oh yes.

You have a concept of reviving it? Could it become live, under what conditions could it . . .

Well, I'll tell you the machine we've got in there is like a . . . we had a two million, one or two megabytes of memory and the machine was called an Eclipse, a Data General Eclipse.

That's what ran it. A general purpose .. .

We were in the process of changing the programming from a thing called, some kind of a scientific Fortran . . . dumbass, if I'da known anything I'd wouldna never done it . . .to C. Trying to have a little better system. We were cramped in that machine. We'd do some things and when we'd do a compile sometimes, shit a compile would take an hour. Well, nobody wants that. That was so disheartening after all that effort. So when we were closing up essentially we were still pumping money into the computer. Then we took that machine and we didn't get paid but I took some of my key guys, Ed and Bill and Pete. Pete was an artist and our sales manager. We got some guy that had a really nice studio, or a nice building, to give us free rent. Beautiful offices and everything. God, it was unbelievable. And we had our machine set up there and we tried to interest Hanna-Barbera in some of the techniques we were doing and what we achieved was a rotation with talking and lip synch and so forth on a head, on a Hanna-Barbera head that was . . . we could turn that sucker around and it looked just like it'd been animated by hand. What we were doing was using the machine to . . . and we were trying to develop a numerical system for describing animation that in conjunction with the sound track would be a description for animation and we had numbers for head positions and body positions. It's not perfect by any means but it wasn't bad.

Tell me, when was System 4 finished in its full form?

We shipped our first one in 1980. We started developing it around '75.

You kept on developing it until the end of the company, until '85?

Yeah. Actually we were still around in '86. We went back into the production business for a short period of time in '87. Did a few things and then it just didn't seem to be working out and we . . .

Tell me, who knows the most about these machines? Are there any System 4s running anywhere since you had 4 more abroad? What happened in these other places?

I'll tell you. The quality of the method of the video data handling was not . . . the ADO put it out of business. You could put real time, live stuff through it. You do a few spins and warps and stuff and you could do it rapidly, inexpensively with high quality and that put us out of business. In the meantime, the creative energy that went into making these machines work . . . there were some really marvelous things done that will never be duplicated. We could do flames and we could do wonderful, beautiful stuff.

So do you have any scheme to revive that last machine, the number 5? You said there was one sold to Luxembourg or two?

We sold them a Scanamate and a System 4.

Do you have documentation on that?

Oh sure.

Because we could track it down.

Let me tell you something. I own that machine. I don't know what they've done with it but our contract . . . and they were very contract-oriented people . . . called for the return of that machine at their expense after 1990. And I've not heard from them and they might argue that we called your number and you weren't there 'cause there's no Computer Image but they've not made any effort to contact me. All of them have my home number. Many of them have stayed here. I loved the Luxembourgers and they loved the Americans. Battle of the Bulge. Just loved it. Renny Steichen is probably still the head of the production facility for RTL Productions. You heard of them? Radio Television Luxembourg. They're big.

Sure. We know about that.

But it might be that if they haven't destroyed it or whatever that they may . . . do you want to buy it?

Which machine do you own? System 4 or the Scanamate.

First of all, I want you to know that Mary Lou and I lent money to Computer Image to get it going again and in order to do that I said I want . . . and I filed papers so that all the assets of the company if they defaulted on the note would be mine . . .

We'll put it in the Smithsonian for you because as you see we are just . . .

Well, I wrote to the Smithsonian and I told them about Scanamate and I got a form letter back, you know, write to this guy or write to that guy and have some suggestions about how it could be displayed and everything. I wrote some nice letters but I never heard back from them. Ever.

You see, we encountered the same trouble with audio. They were supposed to buy a Buchla machine. You know Buchla?

Yeah, I think I met him.

The Buchla 100 which is at Mills College but the French came and purchased it so Smithsonian .

. . So this is the Solar Eclipse machine. It's one of the most remarkable constructions of the twenty-first century and I tell you, it's such a shame that it doesn't exist on a model scale because this would deserve a (?) moving and operational in some sort of a corrugated iron nice building and this would be just sort of a fantastic installation, like an artist installation you understand.

Goddamn it, Woody. You should be a curator.

I'm only a humble artist. I just ventured into this curatorship by innocence and foolishness but I tell you . . . there's only five minutes left on the tape but it's no big deal we have most of the data. Why don't you take just three minutes to describe what happened with NASA?

Years ago there was a concern about the cost of poundage in space. For every pound that went up in space there was some huge amount. I also knew that there was a lot of study going on and once I called NASA. This was a long time ago in '62 or '63. Maybe '64. I called them up and I asked them if they would be interested in getting a picture back of the astronaut in space using very low band width which says a lot to people who are interested in that stuff. Maybe voice band width. I'd done a few calculations on it and they said "Yeah, we're interested. How many cameras do you use?" I said, "None." They said, "What are you crazy?" I said, "Look, you already know what the guys look like. That's a priori. You could store that. You put it all together on the ground. You store what he looks like on the ground and you recreate that based on what's he doing up in space but what's he's doing you can detect with little detectors at his joints in the suit or whatever. You can tell exactly, as much as you want to tell. If you're worried about something else you can . . . it's like the President's veto power, you can get as much as your willing to pay for. It's very cheap. And they said, "You're crazy because you can't do it without cameras." And I said, "Well, I think you can." Years later I was talking to some guys from . . .