25 pages

Meeting with
Bill Procter at his residence and Mrs. Procter
Friday August 5, 1983.

O.K. Bill. Where were you born? When were you born? How did you come to get into the sort...

Well, I was born in 1921 and I was born in England in a village called Liegreen, which is near London. I came to Canada in 1947 after I was demobilized from the Fleet Air Arm in England and I joined AVRO Aircraft in 1951, February of 1951. I worked in the planning and tool design department for 2 or 3 years and then we heard that there was a vertical take-off project about to be designed at the plant and some people were put together to form a production team. Mr. Gordon Kels was going to look after all of the production and all of the tooling and he became manager of production and tooling and I was given the task of taking care of the tool design and any subsequent that would be required. Initially, of course, the project started out with a series of models. John Frost and Des Earl, who was his chief aerodynamicist were working on a series of vertical take-off studies and they produced a number of small models in order to make sure that the wind defects that they wanted and the lift effect co-efficients that they had in mind were going to work out correctly. This occurred about 1953, had been in operation for a couple of years, I understand even prior to 1953. The original vertical take-off concept was called Project Y. A mock-up was built and it was in the flight test hangar at Maltan AVRO Air Craft and I believe that's the airplane the Montgomery came over to have a look at, General Montgomery, of course. And he was taken on a tour of the plant and he had a look at this supposedly new supersonic ver-

tical take-off aircraft. There was an article in the paper at that time, I believe that would probably have been around 1949, 1950. I didn't get onto the project though until 1953. My background, of course, in England, I had served an apprenticeship with Air Speed, I started with them in 1938. I served three or four years with them prior to going into the services and then I rejoined them after I came out for one year before I came to Canada. This put me in good stead, presumably, for the position of planning and tool design supervisor. All we knew about the project at that time was that it was super security class. We would be working in a special building across from the main plant and it would lead to the construction of the vertical take-off aircraft. The aircraft as depicted by John Frost at that time was going to be called Project, I believe, 714. It was about 40 foot in diameter, would have six Viper engines impinging on a central turbine and the compressor blades would be mounted above and below this turbine section. The turbine would be in 4 stages - 2 rotating counter clockwise and 2 clockwise, with a very numerous number of turbine blades that were all manufactured for us by an outfit in California at the time. We made a visit down to a place called Turbo Products, these were the only people making hollow turbine blades and we were able to get them to design and produce the blades for this particular project. The six Viper engines were purchased in England. The airplane was going to have 96 afterburners situated in the circular wingtips and these were ordered from _____ I believe, at one time, but

the airplane never did get completed. It got as far as a test rig on a test stand. We built a number of models, as I've said before, that led up to the construction of the actual aircraft and we then went into construction of a pie shaped piece of the airplane, which was mounted in the test rig in order to prove the potential of vertical take-off. That airplane though, or the airplane that was going to be the culmination of these tests was eventually cancelled and replaced by the AVRO Car Project. I believe, at that time, that Mr. Frost was able to go and talk to the Canadian government and the military in the United States and was able to get support for the AVRO Car Project both from the USA and by the Canadian government. And then work was started on the AVRO Car, which was a much smaller airplane, with only three Viper engines, a different type of turbine and compressor and three eventually were built. One was tested at the AVRO plant and various pictures have been forthcoming showing it in the ground cushion. Another one was sent down to the Ames Research Center in California. Mr. Gord Kels had quite a memorable trip with that airplane because it was taken down the Hudson River out to the east coast, put on a barge, transported down to the Panama Canal, through the Panama Canal up the west coast to California where it was placed in the Ames Wind Tunnel, full sized tunnel in California and then underwent a series of wind tunnel tests. In the meantime, John Frost was proceeding with the AVRO Car modifications at the AVRO Aircraft plant. And a third vehicle was put into production. I believe that the car, the termination of the project that one of these went to a museum in the

United States, the other one was scrapped and I'm not too sure what happened to the third one. That would bring you probably up to about 1959, when I came off the project and rejoined the main plant and, of course, at that particular time, we had lost the Arrow contract and the company was working on a various number of projects that were being funded through the defense production department prior to us trying to get a new contract for DC-9 wings. All in all, I suppose I spent about 8 years on the project and found it very interesting while I was there. Certainly, in retrospect, would have liked to have seen something finally come out of it. I do know that a number of the people that work in the design team were transferred to DeHavilland Aircraft and they've been working there and they've been working on several designs for _____ wing vehicles. As you know, the DeHavilland Aircraft had an aircraft that they were co-sponsoring with Boeings in Seattle, using one of their buffalos with a blown wing to see if they could get augmented short take-off and landing capabilities from the airplane. So, a lot of the reaearch that went into the so called flying saucer airplanes wasn't lost. It would up in various other projects across the country. Des Earl himself, I believe, eventually went to the United States and became quite predominate in ground cushion vehicles. The AVRO Car turned out to be a ground cushion vehicle, although it never did really fly. It got as high as 4 or 5 ft off the ground and I believe that they ran into a number of serious stability problems which were to require expense funding and a lot more design and research before they would have been able to have come up with

solutions to the various problems. I think possibly that's why the United States decided at that time to withdraw their funding for the project.

(How familiar, Bill, are you with the sort of cross funding of the Canadian government and the United States government. Whether it was joint or separate at one time at different stages. Are you familiar at all with that?)

Not the specifics of it. I believe it was probably funded by the company initially. John would have then solicited some support, I'm sure, from the Canadian government, and they would probably have subsidized the project up to a point where John Frost then starts to get the U.S. military people interested in the project. So, I believe what probably happened here was the United States, when they heard that there was an airplane company in Canada developing a revolutionary type aircraft, they probably wanted to be sure that if it was developed they'd have some control over it. If it was successful they would be able to say that they had part of it's production and development so that they could be responsible then for producing it themselves in the United States. So, I believe this why they then funded it in order to make sure that they weren't left out of the picture. Now, when the AVRO Car started, I think their funding was probably greater than the Canadian government at that particular time. A number of concepts of the AVRO Car were being developed on paper. A lot of these paper sketches have been supplied to the military in the States and they showed that the AVRO Car could support some kind of a gun platform, it could be used

for reconnaisance, it would be an ideal vehicle for taking off of rough terrain or from highways, very similar/to of course, the present day Harrier airplanes, except that the Harrier is a conventional airplane insofar as it has a set of wings and a stabilizer. Whereas the circular airplanes that John Frost was involved in, at that particular time, never did have any other stabilizing mechanisms other than the jet that was supplied by the main engines through the turbine and compressor blades and the way that the jet/discharged was from the periphery of the airplane. And I think that John always felt that if the airplane was going to be successful and/revolutionary be then he had to stay away from things like stabilizers and rudders and the normal conventional types of control. But as to the proportion of funding, no. I would have no idea just how that was broken down.

(This project weapon system 606A, does that ring a bell or mean anything to you?) Well, if the numbers had any kind of continuity, then the first parts _____ was involved in was 704. (That _____) Yeah, then came the AVRO Car which was 705, so I have to believe that the one you are referring to would have pre-dated both of those and could have been before I was actually on the project. As a weapons system, I think they were all regarded as weapons systems. That particular model that you have in the box was depicted as not requiring any guns or cannon because, as you can see from looking at it, the sharp leading edge was such that it could collide with enemy aircraft and cut it to pieces, in fact, several sketches were

supplied showing that as a supersonic airplane. (This one in the box this little disc model would pre-date your involvement with the..) I think so, it looks like it pre-dates 704. But if you look at the pictures of 704 you can see that as a forerunner to that airplane it was definitely very similar. 704 had a round canopy, the pilot sat in the center/where the control column came up through the center shaft. The model that you have has a typical, (elongated) yes, aircraft canopy with the pilot and the navigator sitting one behind the other. (You were mentioning earlier, Bill, about these things, whatever they were.) Well, the 704 project, as I said before, had six Viper engines, the jet thrust impinged on a circular set of turbine blades driving the compressor blades. The air was then directed through each of the wing sections spread around the circular outside shape and when it reached the peripheral wingtip the air was augmented by after burners, or is going to be if the airplane had ever been built. And each of those afterburners were set between two rib sections so that would provide additional thrust. The thrust was then turned through a series of nozzles. I think John Frost's idea was that in vertical take-off all the nozzles would be opened vertically and the airplane would take off vertically. And then for forward flight the nozzles would be gradually closed proportionately so that more thrust would come out of the aft end of the airplane than the front and the airplane would then start to move forward. It would then pick/up aerodynamic lift and would become a flying machine. I think one of the problems that they had with all the circular airplanes is that the center of gravity was obviously through the center of the airplane. It would have to

be to be able to take off vertically. When it moved out of the ground cushion and picked up forward speed and became an airfoil the center of pressure within that airfoil moved aft. Now, in normal airplanes that is counterbalanced by the stabilizer. Since the round airplane had no stabilizer, that center of pressure movement aft, behind the c.g. gave the airplane an unstable condition and the only way to correct that unstable condition was by directional flow of the jets within the airplane boundaries. Now that became a very complicated design problem to get that to work at all speeds efficiently and subsequently the AVRO Car never did enter forward flight. I think if you read that Air Force report that you showed me on one of the test flights the pilot says that he made several ground cushion flights but that's all he ever did. The minute he tried to move the airplane forward and have it operate like an airfoil and pick up lift, it became an unstable vehicle. Whether they could have overcome those problems or not, I'm not sure.

(I've got a couple of copies of photographs here, Bill, that might interest you.) Yes, well they would predate 704, too. (That is supposed to be 606 Supersonic.) Um hum. (I'm a bit foggy and you are the first person I've asket it. I'm not trying to be a smart alec, but from what I've read extensive reading on this now, government stuff, United States, it may trigger a memory. It seems to me that Project, Weapons System 606A was in 2 distinct sections.

One section of Weapons Section 606A was in fact/the subsonic AVRO Car test vehicle for the check of the ground cushion. The 606A super sonic is what you're looking at right now. This I believe. I don't know. I think this is a derivative, if you like, of the 606A, as I say, I should not be the guy that is telling you but this was, these original photographs were listed at Weapons System 606A.)
Well, you could be right. At the time that I was on the project of course, the design people were producing numereous different concepts. The model that you have in the box, the 704 that I worked on originally were all supersonic or were supposed to be supersonic airplanes. The AVRO Car was a subsonic vehicle. And the series of AVRO Car vehicles were all subsonic. However, as part of that package, that weapons system package, that doesn't mean that John Frost wasn't offering a supersonic version which could have been exactly as you described it. These photographs could, not photographs but artist's sketches could have been the artists attempting to depict what that supersonic vehicle would look like.
(This is what is evolving to me, Bill, reading through here as an outsider. Here's another one that might be interesting to you. A brochure I picked up in my travels and you see what it is... Engineer Experimental Program for the design and development of radial/jet aircraft. This is December 1954 and there are two or three aircraft in here and I think that it is _____ to become a little interesting predating yourself. 8 Vipers. This, I believe was Project YII. This would be the second one. Y being the first,

and Y, I'm not trying to tell you, but this may trigger some memories or something. You would have been a lot closer to this than me. Y was a major shape animal.) It was called the Omega. It sat on it's tail and had a long.... (at an angle and it was fired at an angle almost _____ on the front and two wheels on the back, for take-off and it landed, I'm not quite sure it landed the same way or whether it landed flat. But... I've got some other things. This is the one that Monty saw.) That's right. (And it also broke in the Toronto Star and this is some of the, a couple of hand drawn sketches by our friend Vas Czerwinski, there that. (That's pretty well what the mock-up looked like and, of course, it never got beyond the mock-up. It was a wooden mock-up situated in the flight test hangar at AVRO. And as one of these sketches depicts, it was going to have a large round engine contained within it. It would have taken off vertically, presumably in the tail position that you see in that sketch. How it landed I have no idea. (Filling in again, from what I've read and what I've picked up along the way, it seems that this one, the Project Y, YII and the 1794 was a very radical type of design that were about 35', you mentioned 40 and knife edged and it had 8' counter rotating propellers I guess you'd call them and this was a kind of a jet engine squashed flat down. A very radical type of idea. Counter rotating it would give the gyroscopic effect or something like that.) Well, the gyroscopic effect presumably was going to be the way they were going to stabilize the vehicle but when I came onto the project I know there was some large pieces of material that had been ordered which I was told were going to be part of the engine if it had ever been built.

These were something like 15' in diameter and presumably Project Y was going to have a large flat engine like you say, counter rotating which would have been revolutionary in the engine design alone, let alone the vehicle but it _____. But, long before that ever reached the stage of serious design work, John and Des Earl, I'm sure, had changed their ideas about what the vehicle would look like and they had started working on a completely circular airplane that would take off vertically flat and then would proceed out of the ground cushion and would attempt into powered flight by picking up aerodynamically and the first vehicle of that nature that I saw was Project 704. Which is very similar to what you've got in the box. It's very similar to what you've shown me in the Weapons System 606A. The only difference being the intake configuration and the cockpit configuration. That would be... That would be project Omega. (Yeah, the Omega. This is the newspaper article. This particular one was in the Airplane in Britain and this was a sort of a pick-up from one that was in RAF Review and in turn goes back to Stevenson in the Toronto Star right about 1952.) Well, that's got a rounded leading edge so I have to believe that the original Project Y with the pointed leading edge tail sitter was then followed by Omega and that, in turn, was followed by the round configuration, cause if you look at that you can see that it is heading in that direction. (That's right. That's the one, that's the next one we come up with is YII.) There again, you've got the circular type cockpit. (Yeah, there's variations, all sorts of artist's impressions. Of course, artist's liberty, you get all sorts of wierdos and it becomes very difficult for me to try and get these in their right spot here.) What you have to understand, I believe,

is that while there might have been four airplane configuration types that John was working on; Project Y, Project Omega, and then the circular series of airplanes, there were literally hundreds artist sketches of variations that John Frost probably proposed to the military at different papers that he presented in the states. And these artist drawings that they produced were an infinite variety. (Yeah, they'd be just triggered and actually all these series designs are an evolution through of changing ideas and it was suggested in one of the interviews that I have conducted that this was always geared also to funding.) Absolutely. (You know, can't we do something, not _____ can we cut back a little bit, improve as we're going along, make it a little cheaper so we have to change the design again.) One and all, on the _____ I think John Frost was a good salesman and probably a lot of these sketches served the purpose of sales presentations. (Yes.) But if he was looking for funding and he could put some visual pictures up on the wall for the military people to look at, that got their interest arounsed, certainly. But, I do believe the configuration of the various vehicles broke down to the four or five types that you've been showing me. (I wish I could find somebody that had a sketch of that Mohawk? that's) That's right, (a sketch or a drawing... That didn't last very long, I don't believe. It was probably destroyed right after Monty's visit. Not long after, I'm sure. And I don't believe there was ever a mock-up of the Omega. (While we're on this - I'll leave the tape rolling there, this little booklet here, somebody, illustrations and stuff and also some _____.

I can fill you in positively on 2 of the saucers, the AVRO Car _____ the grey one here is on display at the Air Force, Army Air Force Transport Museum at Forst Eustace on a stand, (yeah) and well, have a look at this little sign that's on it and have a little chuckle about where it was built.) Incidently, looking at that photograph you will notice a series of vanes, (around the periphery) yeah, around the periphery, if you can call that the leading edge those vanes are sticking out _____ of the leading edge, itself. That was a modification that they funded from the United States after the AVRO Aircraft plant had closed in 1958. When the Arrow was canceled everybody was let go at AVRO, as you know. And even the people working on the AVRO Car at the time were also terminated. John Frost was instrumental in getting a follow-up program with the United States and that follow-up program was to see if they could overcome the instability problems of the circular airplane. And that was one of the modifications they put on at that time. (This is the jet _____ they were talking about then) Yes, yeah. And as a matter of fact I was recalled to the plant to work on that particular development that you see there. (That's the top one, the gray one is a Fort Eustace, and this one, I have on good authority matter of fact, that's why _____ _____ This is the one in the Smithsonian, a little tatty. This came across from Ames. I just received the documentation and talking to Al Weilband, when he was down on some augmenter wings stuff, they asked him about if they had cut it up, make it in three pies to ship it. And he thought they had but they, I wrote the Smithsonian and asked if they could give any details of how they received the _____ and they sent

me all the details including photographs and the large box that Gord Kels transported down.) Yeah. (Had big boxes made,) that's right. (The diminsions on the box and a photograph of it being put into the box, and the photograph before it went in and after it came out of the box, so, great documentation and the fact that when it was transported there from Ames, so I've got good documentation on there. You might get a little chuckle on this one... This is the sign that was and the letter right above here tells you why. A friend of mine took the photograph of the animal at Fort Eustace. You may, come as a shock to you to know that it was produced in the United States. I wrote with tongue in cheek to the curator of Fort Eustace and said as a Canadian Historian could you advise me where the plant was in the states of AV Ro. I was unaware and the letter I got back was the one right here and tongue in cheek, he said, well sorry about that old chap, must have been the interpretation of spelling or something in Idaho and Canada, having it changed. I don't know if he ever did have it changed, I haven't been in correspondence but it's rather amusing, claiming, you know,) Well, reading that, that really says exactly what I said about the fact that it was the instability of the airplanes that finally led to their cancelation. It's interesting too that some of the photographs, I don't happen to have any, but when one of the vehicles was in the Ames Research tunnel in California, the first thing the aerodynamicist down there did when they ran into the pitching problems was to install a standard conventional type stabilizer and rudder. You'll see photographs of that. (I talked to Al Weilband) (I've never seen the photographs, I've seen it on film, but I've never

seen a photograpy.) I think they believe that if you had.... (These other photographs are Spud _____ flying the animal and a few of his friends up there.) But John Frost wanted no part of stabilizers or rudders, so as far as he was concerned that would have been the end of the project. But that's interesting that AVRO Aircraft is in South Bend, Indiana. I'll have to show that to.. (I thought you'd appreciate that. This is one, just in passing, I'll let the tape roll This is photograph that one of the boys had and you may) Lot's of people standing around.. (Well, I was desperately looking for who they were and it's funny, reading from your left here, I'll read them off to you. Ed Kalman, Don Whitley,) Don Whitley is now with DeHavilland. (Al Galbraith, Roy Nelder, Alec Barnes, Ben Lockwood, Ralph Benge, Gordie Kels.) Now Ralph Benge worked with me in the planning and tool design department and he was my assistant until he finally transfered and became Mr. Johnson's assistant. Johnson was administrative engineer on the project. (If I call these out, if you have any knowledge wherethey are, I do know where some of them are) Well, Ralph Benge went with the Department of Defense Production. He worked up in Ottawa for a number of years and then he took the post of the representative in the West Coast and he moved to British Columbia. And I think he's now retired out there. Next to Ralph was, you were at Ralph Benge. (Well, going backwards a minute, if we're talking about where they.. Let's start at your extreme left, Ed Kalman. Any idea where he is?) No idea. (Don Whitely I know, I've talked to Don.) Don Whitely at DeHavilland's of course. (Al Galbraith, he's at DeHavilland's, I talked to Al.) Is he? He went into his own business for a short while so he must have given that

up when he went to DeHavilland's. (I've talked to him. And Roy Nelder?) No. (_____) Yes, he was. He possible went with the Fischer Body Company in the United States, working on automobiles. Quite a few of the fellows that were in _____ department wound up with Fischer. (Alec Barnes?) No, I don't. _____ design, he was Irish. (Ken Lockwood, I've talked to him. Ralph Benge we've talked about, now Gordie Kels, he's retired I've talked to Gord. Doug Ferguson, that's the one I'm looking for Chief of Stress.) Yes, Doug Ferguson, he worked with Des Earl, of course. (Any idea where he is?) No idea at all. He was a likeable chap too. (I'm trying to find him. I've been advised he's around _____ there.) Could be. (Bert Rhoden, he's in Kingston, I've talked to him. I've got to go down and visit with Bert.) Bert Rhoden is a character. He'll tell you that anything round should be successful. (I've heard that _____. Arnold Rose?) He went into teaching I believe and you've talked to him. (I've talked to him a little bit. Eric Johnson, administration. I believe he's down in the states. Ken Shattuck?) Ken Shattuck, the last I heard from him he was in Brampton. He had, was trying to start a small design office business of his own where he would take on _____. (He was in structural design.) Yes, he was. (Don Barkely?) Barkely, yes, he ran the structure department. I think he was a supervisor. (Any idea?) No idea. (Bill Hill, he's with Lockheed, he's working on submarines. He's in San Jose, California.) He's an English fellow, came over from England. (Morgan Rand? Aerodynamist?) Don't remember him.

Stan Meekins, administration?) Remember him. (Harry Beffert?) Now Harry Beffert was never on the project at all. He probably got into the picture because when the AVRO Car reached the point where people thought it might have been a successful production venture it was moved over to the main plant and so some of those photographs I've shown you of the AVRO Car in the main plant, Harry Beffert would have been the production manager had it gone into production. Harry went, retired...(He's very sick the last I heard. I don't know if he's still with us. It was nip and tuck at the moment.)Al Weilband I've had a very interesting..) You tell me he's retired. He's an English. (He's retired from DEHavilland but he's got a little side line, very active and very, documentation with him is marvelous. Claude Williams, control design?) Yeah, (No idea where he is?) No idea at all. (Duke Redge, plant superintendent?) Well, Duke Redge died, of course. (And Jim Stewart?) Jim Steward ran the design office. He was the administrative design chief. He went to DeHavilland's but what happened to him after DeHavilland's I've no idea. He also worked on the Hydrofoil project. (Oh, yeah up at DeHavillands.) Yeah, and then when the... well, you know the Hydrofoil project came over to AVRO when AVRO was taken over by DeHavillands For a short time we were DeHavillands. (Yes) And he was there at that particular time. (The last gentleman, of course, is the leader John Frost, who passed away a couple of years ago in New Zealand.) New Zealand, yes, that's right. (I thought you'd be interested in that one anyway and Al Weilband identified most of those. It's rather interesting. I've just got to find some. I'm quite sure there are others than there) Well, you've got most of the design

team there. (Yeah, it's a matter of memory and I'm telling you, there seems to be a great raft of technical information on the latter stages of it that have survived and theAVRO Car, itself and the AVRO mobile series of vehicles that were proposals....) Probably because there was a larger staff then. (Well, all sorts of derivitives, as you said, the early there. They're all sort of sketches on a piece of paper.) It gets very shadowy when you go back to Project Y and the Omega Project, it gets very shadowy. I doubt very much whether there is more than five people. John Frost and Des Earl would have been the predominant two designers at that time. When they finally got AVRO the company to become interested in the Project to the point of building a vehicle that's when you would have started to get the documentation that was put together. Now that didn't happen until about 1953. So prior to 1953 you're lucky if you are going to get artist sketches or pieces of.... (_____ is sketches more than actual drawings.) Bits and pieces out of newspaper reports. (I would dearly love to get a sketch or a brochure on Project Y. Having got this little bit of information on YII, with the eight Vipers, but anyway that's where you find it. What are your thoughts Bill, on the saucer project itself?) Well, it was very interesting for the five or six years that I was on it. Obviously, we all thought at the time that it had possibilities and it was a completely new venture. As a sidelight to the actual construction of an aircraft, if you remember at that time, there was great interest in flying saucers because, (I think there still is) yes, but in, at that particular time there had been that surge of reports over the United

States that there had been sighting over Washington and sightings over Dayton we had several people write to the company from California and some of these were real weirdos. And what that wanted was the fact that they wanted proof that a flying saucer was built in Canada and they wanted to be able to add that to their information they were.. (You were saying Bill, that you got some letter coming in from all over the states and Canada.) Well, I'm trying to think of one particular person who wrote several books on flying saucers and talked about angel hair and talked about these people that came from outer space and it's, how they were godlike in appearance and I think what he was looking for was some support from the company in Canada that it wasn't just a rumor that a flying saucer was being built but that it was actual fact and then he could have used that in order to further his own documentation that he was trying to put together which I believe was just something out of his own imagination. Because the tape that he sent us was a rambling type of tape. It went into all kinds of religious connotations with flying saucers and Jesus Christ and a lot of other things. (It's kind of a fascinating _____ I find in fact against fiction because as you say, people's imagination running riot and this is why it suddenly becomes quite interesting to me to try and document facts but it's awfully hard to segregate what is actually fact to, not from people like yourself that worked on it but the things you hear. Fact from fiction, and you see these things in the newspapers and, of course, they've only got to get a germ of an idea and when they can flash something across a newspaper that takes off and creates world interest-some wayout Buck Rogers

type thing and the poor old company has to sit back. I felt though in the people I've talked to, some Ex AVRO types, DeHavilland types, etc., to me, speaking as a layman, they are rather learned and very educated and knowledgeable people, but there is two distinct fields. There is the group of engineers that said this was a rip-off, it was crazy, stupid beyond words, impossible dream, Frost was a dreamer and.....) Well he had people on his own staff, I think, that were definitely opposed to some of his ideas and tried to tell him that aerodynamically they would never work but I think Frost was of the opinion that if you didn't start somewhere and he believed that if he could get to the point where he could put the problem on paper that he could find a solution for it. (Well, I was leading up to I think it's marvelous that there was a company that tolerated John, that's not what I mean, but permitted him to go ahead like that, encouraged him and that there was a government, whether it be Canadian and United States, Canadian alone or America alone that I think we need these men of vision even if they are a bit of cookies at times, to step into the unknown, and I wish I could quote it word for word, verbatim of John F. Kennedy, or/~~rather~~ whether it was his brother Robert, who said, "I look and I wonder why not?" And I say,why not? Because it was never there and never done before doesn't mean to say it cannot be done. And there are theories that have been proven wrong and it's great. It's like the pioneers of this great land. People came into the unknown and they didn't know that they couldnt do it so they just went and did it. And this also happened, of course you are very much aware of in the Arrow. I've talked to people 25 years down the road and they've said to me - Les, you know, we didn't

realize the immensity of the project and the problems we were approaching. We just were confident we could do it and so we just went ahead and we did it. Now, 25 years down the road, looked at those things and said, "By God, the audacity we had to get into there with both feet when nobody had been before and just do the damned thing." And I think that's marvelous really and that's been a great credit to all concerned.) Well, every so often a project comes along that is a quantum leap ahead of what people are working on at the time. I think probably the series of circular airplanes were, fell into that category and whether you could have ever found enough funding to have been able to afford to iron out all of the problems and come up with a successful vehicle is something that I can't answer. Whether the vehicle would have been practical as a passenger carrying airplane or even as a military airplane I can't answer. There's no doubt that a lot of the ingenuity that went into it though wasn't wasted. That it wound up someplace else and it finds a niche in the history of aviation, obviously. (I wonder, too, if John was perhaps so far ahead of his time, so far ahead of the state of the art, you know, what he was trying to do, it was a, like, talk about landing on the moon. It was a gigantic and fantastic step and normally somebody mentioned to me that the risk, I forget what they called it, but the sort of stepping forward, you don't normally make a gigantic step you step forward very cautiously and prove it as you go. If you take a gigantic step you get so many problems that they become overwhelming.) Well, not only that, I think usually it isn't acceptable in the minds of other people because it hasn't followed on from something that they understand. It's happened in automobile design, it's happened in the

design of all kinds of projects that where you jump a generation ahead even in the style of an automobile, if it's not acceptable by the public it usually turns out to be a failure. The AVRO Car series of airplanes and project 707 was a dream by John Frost that probably with sufficient funding could have one day become a successful vehicle. (Just as a matter of interst to yourself, I talked extensively to Spud Vitakey, who was involved with flying in the broad sense that he didn't get too far from AVRO, the AVRO Car and he swears that it's something for the future and Spud, there's no question, by all standards is a brilliant test pilot. You,know he didn't poon-pooh it and say it was an idiot thing.) When the jet airplane was introduced people looked at it and said it will never work. Or you can never fly at that speed. (When the airplane was introduced, you go back, _____ they thought Wilber Wright and the boys were rather nuts, too.) (Bill it's been wonderful talking to you. I appreciate your time and talent. I haven't tried to be a smart alec but I have done a lot of reading and I've got a lot more to do and I'll just discuss a few more things after we put this tape off.) O.K. And I'm jolly sorry that I haven't got more to offer you in the way of... (Oh, that's fine, every little bit helps if it only confirms or stops me dead in my tracks with a thought that I've got and proves that I should do a little more research or it's not quite. I have to get confirmation before it goes down onto paper, otherwise somebody like yourself is going to read it and say that's a lot of malarkey. If you do that I want to be able to say to you, Bill, this is why I said it. It may be news to you, as it was when I put the Arrow story together, but Bill, I do really appreciate you spending your

sharing a few memories with me.) O.K. Les. (Thanks a lot.) Only too pleased to help.

(Bill's going to show me here and we've got the tape recorder going and how this 704 worked. This is one 102 inch diameter impeller blades and they were 12 inches high, built then in California.) Well, the blades were manufactured in California. We assembled them in Canada to the rotor rings and we then manufactured the 102" diameter turbine and compressor section. Now, Les, as you can see from that little sketch, that's like it cut right through the center of the vehicle, the jet engine was installed, (there in the wing) six equally spaced around the circumference, with a fan type jet pipe so that the intake air came into the vehicle on the top and bottom (above the main wing) yeah, because the air was now being sucked in, had to pass through the compressor stages and then back out through the wing sections where it would pass through the after burners and then finally out through the louvered exit, (these little louvered things on the periphery) that's right. (I see.) And there was something like a hundred of those spread all around the periphery of the airplane. They gave the direction, vertically, then they would be opened so that all the jets would come underneath and for forward flight they would be closed at the front of the vehicle and opened at the back. (I see) But the air was actually sucked in all around the vehicle, course you would be getting more air in the front than the back as it started to move forward and compressed through this series of ~~this~~-compressor here, four stages, and back out through the wing. (This is what Vas Czerwinski and Al were talking to me, and it's a bit thick getting through to me of how this air got into the...)

--Well the engine is driving the turbines. It's pointing away from the center. (The tail end of the engine is out of the edge of the periphery of the circle, the tail of the engine, that is the back end.) No, no, no, (so this is the intake of the engine, in the center?) No, the intake of the engine is here. (The intake of the engine is on the...) On the jet thrust of the engine is impinging on the turbine blades and driving the turbine around, clockwise around, clockwise depending upon the pitch of the blades. They in turn are driving the compressor blades which is sucking the air in through the top and bottom of the vehicle. (_____ get back into this edge? This afterburner?) Well, it passes out through all of the rib segments between the engines, if you look at it circular you've got an engine there, engine there, engine there and an engine there but all the way around the vehicle the air is going out through the various ribs. So the whole center of the vehicle is completely full of air, like a blown wing, again. (So there is an awful lot of bending of air there, where it comes in) That's right. (And it bends and comes back along..) No, no, it doesn't come back along. This air that finally comes out of the vehicle is the air that's going to produce the thrust. (Well, wait a minute, it comes from the center of core, it comes in top and bottom, it goes through the engine,) No, no, the engine's have started up. (Right) All right, and the engines would then drive the circular turbine. (So the air comes in there and...) No, it's only coming in there, when the turbine drives the compressor to suck it in, the air that's coming in is just air that's been sucked off inside the vehicle. And if you didn't have enough air in there the engine would stall. (This is

where I'm getting confused. We're thinking of two air flows here.) Right. (One, that goes through the engine that is drawn from within the vehicle itself.) Yeah (And then we've got the other air) That is coming out of the jet pipe and the jet pipe is impinging on the turbine... (Yeah, the jet engines that are buried in the wing are really just to drive this massive turbine) Exactly. (The massive turbines are driven by these small jet engines. It's not the power from the Viper engines that drive the turb..., that drive the machine.) No, that's right. (The Vipers simply make the big turbine do the work) They are a component of one large engine. (Yeah.) So, the engine consists of six jet engines, (Yeah) a four stage turbine and compressor (Yeah) and 96 afterburners around the outside of the vehicle to augment the thrust before it leaves the vehicle and it's that final thrust that comes out that powers the vehicle either vertically or forward. (Really, my, as a layman, I'm thinking of six jet engines being the power plant.) No, no. (They're simply the generating power of this monstrous revolutionary 8 ft. counter rotating radically designed jet engine. They are simply the propellent to get that thing moving.) (Just like water would be the propellent to move a water wheel. (Right. Now, that's a good analysis, there, really, because the water is these six vipers and the water wheel is this monstrous new revolutionary engine.) That's right. (Thank you Bill, it was worth it, in itself.