The Reminiscences of

RICHARD M. MOCK

Aviation Project

Oral History Research Office
Columbia University
1960

Library of Congress Cataloging in Publication Data

Mock, Richard M 1905-
The reminiscences of Richard M. Mock.

Transcript of an interview conducted by K. W. Leish for the Aviation Project of the Oral History Research Office of Columbia University in 1960.
Includes index.
Microfiche of typescript.
(New York times oral history program : Columbia University collection ; pt. 2, no. 133)
1. Mock, Richard M. 1905- 2. Aeronautics--United States--History. I. Leish, Kenneth W. II. Series: New York times oral history program : Columbia University collection ; pt. 2,

~~Library of Congress Cataloging in Publication Data~~

no. 133.
MicrofricheTL540.M54 629.13'0092'4 [B]
ISBN 0-88455-136-9 75-5960

Columbia University
in the City of New York
NEW YORK, N.Y. 10027
ORAL HISTORY RESEARCH OFFICE

DIRECTOR'S ROOM

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Louis M. Starr

September, 1974

Louis M. Starr
Director

PREFACE

This manuscript is one of a series resulting from tape-recorded interviews conducted by the Oral History Research Office of Columbia University on the history of aviation, under a grant from American Heritage. Small excerpts from this interview appear in The American Heritage History of Flight, and all of the interviews in this series are offered in microform with the permission of American Heritage, originator of this project, as well as with the permission of the individual interviewed or that person's assign.

Richard M. Mock - Interview I - April, 1960 - by K. Leish.

Q.: How did you happen to get into aviation, Mr. Mock?

Mr. Mock: When I was an undergraduate at New York University, we had a mechanical engineering course, and they had what they called an aeronautical option. Later that was the Guggenheim School of Aeronautics, but when I was an undergraduate it was just called an aeronautical option. It was a special course in aeronautics for a year. I was class of '27, so that must have been around '25 or '26. One of my friends, a class ahead of me, was taking the aeronautical option, called A.C. Falk, who lives in Philadelphia, Adolph Falk. He suggested it. He was quite enthusiastic about the future of aviation. Most engineering graduates in those days had a difficult time finding a job. We were all trying to find things where there was a demand, as there was a surplus of engineers and of young people. I didn't know, and decided I would get a job for the summer; I worked for the Loening Aeronautical Engineering Company, on 31st St and the East River, where the East River Parkway goes through now. I worked there the summer of 1926, and as a result of my experience there, I decided to take the aeronautical option.

During that summer I met men who were working in that shop. Some of them were aeronautical enthusiasts. As a result, I went out to some aviation meets at one of the airports on Staten Island.

The meets then were more or less stunts, to attract a lot of people and then sell rides to them. Rides then cost around $10 to $20 a ride and only lasted a few minutes. Within a few years after that, they became much cheaper. It might be that they were even more than $10 at that time, but that's my recollection.

I remember the first meet I attended, in 1926. The Fokker tri-motor, the Josephine Ford, was on exhibition. You know, there had been an expedition to the North Pole with Admiral Byrd of the Navy, financed by the Ford Motor Company.

I attended an earlier aviation meet, but I don't have a sure memory of it, that might be part of things you're told as a child or part of things you remember. When I was five years old, in 1910, there was an aviation meet at Belmont Park, a racetrack on Long Island, and my father knew the man who was putting the meet on and took me out there. I know they took a picture of me sitting in the seat of an open cockpit or open framework airplane. My memory tells me I was there in the seat, but I don't know whether it's from what I was told or from the picture, which is typical of childhood memories.

I don't know where the picture is now.

Around 1926-27 was the beginning of the effort to make an outside loop---going forward, then down and under---and I don't remember when that was. I don't think it's very significant.

The aeronautical industry at that time consisted mostly of people who were doing barnstorming, travelling usually as a group of airplanes from one community to another, selling rides from a farmer's pasture, in any town where there was a gathering of people who would follow it.

Q: How did people regard this at the time?

Mock: I don't know. I can't tell you first hand, but my impression is that people regarded them as intriguing itinerants. There was no portent of transportation in what they were doing. These were open cockpit airplanes. There was a great variety of them. In the '26-'27 period, they were mostly surplus airplanes from World War I, the JN-4-D, which was called the Jenny, with an OX-5 engine. There was one with an Hispano engine, made by Standard Aircraft, called Hisso-Standard. Around that time, there was an airplane made in Troy, Ohio, called the Waco, and there was a series of Wacos, Waco 7, 8, 9, and 10, and they got to be quite famous. Model 10 was one of the first airplanes in which the two front wheels were not connected with a through axle. That was important, because in landing in these unprepared fields, in taxiing along, if you hit anything with a through axle you went over on your back. So the forward area that you could grapple with was narrowed down to the width of the wheel rather than the whole spread of the airplane.

Q: Did people think there was a future in airplanes?

Mock: There was a great doubt about it. One incident occurred when I was a senior. There was a student who was taking a graduate course, taking the same classes that I did. His name was Grant Mason. He told me he was going to leave school before graduation because a friend of his by the name of Tripp had an idea of starting an operation between Miami and Cuba and extending all through the Caribbean. Mason was qhite wealthy and came from Yale, and I was working my way through school. Two months from graduation I couldn't see quitting school for such an idea, with no assurance that it would succeed. Later Mason became the Caribbean manager of Pan-American Airways. Mason also was an embryo cartoonist and had some allegorical characters and cartoons. I think he took aeronautical engineering so he could be in New York and try to sell publishers his cartoons, with which he was unsuccessful, at that time anyway.

The year 1927 was one that saw a great change in aviation. In the early part of the year, as an undergraduate having bull sessions with other undergraduates---there were five undergraduates and four postgraduate students, as I recall---we were aware that in the graduating class of the year before in aeronautical engineering, only one student had gotten a

job in aviation, two or three in engineering of any sort, and the rest went into the bond business or worked for retail stores or got any kind of a job. So there was a great apprehension about how we were going to get our bread and butter, especially when you had the job of supporting yourself, as I did.

So I wrote letters to some 13 companies and organizations in the period around March and April of '27, which were all the ones that I thought I would like to work for if I had my choice, and all the ones that I thought counted. Included in that was the Army Air Corps Research Center, called McCook Field, later changed to Wright Field, in Dayton, Ohio. Just about a month before final exams, I was called out of class by Professor Alexander Klemin, the first Professor of the Guggenheim School of Aeronautics, one of the founders of aeronautical education and an instructor at M.I.T. during World War I, who is now dead. Professor Klemin said he'd just had a phone call from a man named Earl D. Osborn (who lives in New York now and is head of a company called EDO---his initials---in College Point, Long Island, the EDO Aircraft Company). Earl Osborn was publisher of a magazine called Aviation, now Aviation Week. He had an urgent need for someone to help him with the editorial material because his editor had just quit. The editor, Lawrence LaPage,

lives in Philadelphia now. The magazine was a weekly. Osborn was leaving for the West Coast. Fortunately, they had just gone to press, so they had a week to get the staff together and get another issue out. Osborn asked me to come down and see him, and I did. They gave me a leave of absence at school to help him.

I had done some writing, free lance, trying to make a dollar, and had written for some things in school.

A more important thing is that the same week Osborn hired a man named Sidney Bowen, who had been a pilot in World War I with the Royal Air Force, and also had been a newspaperman and writer ever since. Bowen knew something about writing, and I knew something about airplanes, so between the two of us we hoped we might be able to make sense to the readers.

One of the first assignments I had was to go out to Long Island to Roosevelt Field, which was then Curtiss Field, I guess---two fields adjacent to each other with a hill in between---and then across the railroad tracks was Mitchell Field, which was a military field and is still there. The airplanes for the race to Paris for the Orteig Prize were to start from Roosevelt Field and continue onto Curtiss Field if they didn't get off.

Now, talking about it, I recall that the airplanes were not yet at Roosevelt Field. They were mostly at the

manufacturing establishments. But I was given the job of covering these various airplanes that were preparing for this competition. In the forefront was a Fokker tri-motor that Admiral Richard E. Byrd was to fly, and a twin-engined airplane being built by Keystone Aircraft Company in Briston, Penna., which was a special version of a bomber called the Keystone Condor. The airplane was known as the American Legion and was financed by the Americal Legion. There were probably some ten or fifteen airplanes. If you're interested, you can get the magazine article from the library---it appeared in Aviation around May, 1927.

The prize was $25,000 for the first non-stop flight from New York to Paris.

Q: Did you have any contact with Lindbergh at that time?

Mock: No. I wrote the article, and it was exceptionally long for the magazine, seven pages; because there was so much attention they decided to give it that much space. At the tail end of the article---just to be complete and so I wouldn't be left out by some dark horse winning---I included a paragraph which said that there was an airmail pilot by the name of Charles Lindbergh who was preparing a single-engined airplane in San Diego, California, at the Ryan Aircraft

Company, for the flight. I gave a big play to all the precautions for safety and all the research that these other people had done to make sure that they would be able to make it. Of course, they carried so much gear for safety that they were like putting a patch on top of a patch on the roof of a building until the building wouldn't support the roof. Lindbergh, however, went alone and didn't take all these precautions---standby crew, extra equipment, multi-engines--- so that he increased the performance of his airplane; and it was performance that won and not all the gear.

Q: How long did you stay with Aviation Magazine?

Mock: Well, I was writing for them while on leave of absence from school to help them over this period. I took time off from the magazine to go back and take my final exams and for commencement. I didn't miss much school, because I only started there about a month before I finished school. That added one more company to the list of places where I could go. They offered me a job, asking me to stay on permanently.

I was bewildered when Lindbergh's flight was completed successfully. The result was that everybody who was in the aviation business expected a boom. Here was a group of people crying in the wilderness, and suddenly they were on the front

page, and anybody in aviation got attention. The net result was that all the companies that I had written letters to, each one wrote offering me a job. They were all at $35 a week, which was the standard starting salary for engineering graduates at that time. The rate was paced by the fact that the Government and the Army Air Corps would give that as a starting pay, which was considered high, and everyone else had to follow suit.

I wasn't sure what I wanted to do. I tried to get my appointment at McCook Field postponed until September, which would give me an opportunity to choose, because I was bewildered by all these jobs. The McCook Field job was as a starting engineer junior. But I had all these opportunities, and I didn't know which one I wanted. I thought that by staying with the magazine I would get some experience and get a feel of where the opportunities might be and then decide where I wanted to go.

By September they appointed me technical editor. The title was to flatter me and get me to stay, and I stayed on.

About June of the following year, I interviewed Mr. Bellanca for the magazine, to describe a new airplane he was building which had transoceanic capabilities. In the interval between the Lindbergh flight and this interview, the Bellanca

airplane which had been in preparation for the Orteig New York-Paris competition and wasn't ready in time, flew across the Atlantic piloted by Chamberlain and Levine, attracting a great deal of attention. It flew from Curtiss-Roosevelt Field (called Roosevelt Field in the newspapers) to Kottbus, Germany, establishing a non-stop long distance record which stood for aircraft for many years.

The Bellanca airplane was built at Wright Aeronautical Corporation, when Mr. Bellanca was chief engineer of the airplane division of Wright, before it was Curtiss-Wright. Bellanca had a fusillage which had a cross-section, side-view, that looked like an airfoil, which was supposed to give a certain amount of lift. He had a very good airfoil on the wing, and the cockpit windshield faired into the upper part of the fusilage and the wings so that it would carry air over the top of the wing, without a disturbance. Many airplanes of that time which were high-wing monoplanes disturbed the air over the center portion of the wing to the point where the lift of the wing was reduced and the "induced drag" increased. By having a good wing span one gets what was called a good aspect ratio, which is the tip to tip distance relative to the fore and aft dimension of the wing. Technically, it is the span squared, divided by the area. A high aspect ratio gives you good take-off, good climb, and good cruising

efficiency. For long distance flights one needs to have a good take-off to lift the great fuel load. Bellanca got a higher effective aspect ratio by giving very careful attention to the air flow over the wing where it met the fusilage.

Actually, I'm a little ahead of myself, because the novel thing about it was that it was a monoplane. There was a big controversy in those years about which would be the most desirable aircraft, and people argued, should it be a monoplane or a biplane? In the Ortieg prize competition, the Fokker that was flown by Byrd (which got off later than Lindbergh) was a cantilever monoplane with no external brace for the wing. Lindbergh's airplane, called a semi-cantilever monoplane, had steel tubes going out from the botton of the fuselage to the under side of the wing, about midway out, to support the wing. There was a fairing behind the two external wing struts. I wrote a description of the airplane and interviewed Hall, the designer of the airplane, when he was in New York waiting for Lindbergh to return from Paris. I wrote a detailed description of the airplane. I was interested more in the technical parts of it rather than the flying.

There was another novel thing in the airplane, the first real use of what we call an air inductor compass. It didn't work for a portion of the flight. An air inductor compass

was, I think, the first application in the world of navigation taking that considered the phenomenon of a vehicle carrying an instrument that measured the effect of cutting across a magnetic field on the earth's surface.

In the pictures of Lindbergh's airplane you can see a little pole sticking up in the back of the fuselage on the top, and that's the device that made the inductor rotor spin.

Q: Did Mr. Hall design that?

Mock: No, it was designed by one of the instrument companies.

The Lindbergh flight was in the spring of 1927. My dealings with Bellanca were in June, 1928. I wrote the article describing his new airplane which he was finishing for a new assault on the distance record. As I said a lot about his company and its history, I gave him a copy by mail to read over, to check for accuracy, and asked that he not give it to anyone else. The following Sunday there was an article in the New York Times on the aviation page by Mr. Bellanca which had column after column just lifted from my article, a three column article.

Q: Did you complain to him about this?

Mock: No, I didn't say anything to him. It didn't bother me. I was very flattered. Mr. Bellanca's engineers included one

man who had gone to the same school as I had and gotten out a year before. This fellow, Nicholas Balashoff, called me and asked me if I would like to work for Bellanca. At that time, I was concerned because I'd taken an engineering course and gotten an engineering education, and I'd been out of engineering work for a year. I wondered whether I was going to get so rusty that I wouldn't be able to get back into it, and I wanted to do it as a profession.

Bellanca offered me a job. The factory was at Mariner's Harbor, on the north shore of Staten Island. They told me that they planned to move in four or five months to New Castle, Delaware. The second week I was there they moved. At that time, I was also teaching in an aviation school at Armonk, New York called Barrett Airways, where I taught the ground school. The students had to learn something about the theory of flight as well as how to handle the controls.

Q: Did any of your students there go on to make a name for themselves in the field?

Mock: No. I don't even remember any, except I knew the flight instructor, who cracked up getting out of an airport because the trees were too high and the airport was at the bottom of a funnel. Then, when he recovered from the accident,

he went to work for Pan-American Airways, flying to Cuba. I remember he got a watch with an inscription on the back of it for flying the president of Cuba out during a revolution, which was the forerunner of some of the present situations. His name was Leo Toletsky. He later became a transocean pilot for Pan-American, when they started flying the Pacific (before they flew the Atlantic). He was flying a four-engine Skorski some time during the 'thirties, and he was lost near the Phillipines. They never found a trace of him. That was the end of him.

The activity at Bellanca consisted of building airplanes for transoceanic flights and for executive owners, some real business and commercial operators. I guess we were building a few a month---one, three, four---it varied during the year. I don't recall their cost, but my recollection or guess is that it was something in the range of 18 to 25 thousand dollars for a six place high wing single-engine monoplane.

Q: Do you recall any instance of a difficult sale, where the customer was reluctant to buy?

Mock: No, because I was not active in sales. I recall instances of things that happened that might be of interest, but not in that category.

We had one customer who was a wealthy man that we'd never met, who had an orchestra, and who now is an executive of

Drummond Aircraft Company. I think his brother or his father had an airplane, and he had a pilot. The pilot had been a barnstormer whom I had met through a friend of mine on Aviation Magazine. The barnstormer got into trouble with the New York City authorities because he came into New York, as he would come into any other town, and he landed on Riverside Drive, down below the railroad tracks, in the seventies or eighties. There was a very flat strip there, and he was taking passengers up at so much a ride, until the Police Department chased him. Then he went up to the Bronx, to a field up there, and was doing it again, and naturally, they arrested him. Later, he turned up as a pilot for this musician. He ordered an airplane from Bellanca. I was not involved in the thing, except that I drew up the specifications. Bellanca, like any other company at the time, was thirsty for business and would accept the requirements of a customer without really investigating what the impact of it was.

The pilot wanted what was called Frieze ailerons, because they were supposed to be a better way of getting lateral or rolling control on an airplane. Mr. Bellanca called me in and told me he wanted an airplane like such and such, with Frieze ailerons on it. I said, "I've heard about them, but do you know what they are?"

He said, "No. You go find out."

We had a rough idea that it meant a balanced aileron of some kind. I got a British report of the original Frieze aileron and found out that it was an aileron with a hinge behind the leading edge of it, with a slot between the wings of the aileron and a tricky arrangement of the upper part of the wing between the aileron and the wing itself. How this would work on a Bellanca airfoil was a question to me and to all of us. We ran wind tunnel tests, and we had a very short period of time in which to do this. I went to New York, to an aircraft show, around this time, the winter of '28-'29, and saw a number of airplanes that had what they called Frieze ailerons, but there were no two alike. So I decided that the best thing to do was not to disturb the wing of the Bellanca airplane, but put the aileron in the same location as the Bellanca aileron, so that if it didn't work we could always go back and make it the way we had built them previously. I located a hinge flush with the lower surface of the wing and made it 25 percent back of the aileron's leading edge, so that 25 percent of the area was in front and 75 percent behind the hinge. Then, because I was ignorant about slots, I closed the whole arrangement down so that there was no slot, and had a gap between the aileron and

the wing, about only an eighth of an inch, and then carried the trailing edge wing in front of the aileron around the arc or a circle so no air could pass through the slot or hinge if we could help it.

The airplane flew, and everybody was delighted with the ailerons. They were much better than any Frieze ailerons had been around that time. It was considered an advance. That was the way design was done. It was not done very scientifically, it was just done because I didn't want to disturb the structure of the wing and made it that way.

As I talk about that, I can think of other devices that came about in a similar way. With the Douglas DC-1, they were having some trouble with the possibility of ice on the wing. I was around the Douglas Company at the time, and though I wasn't working for them, I mentioned this type of thing, and the Douglas Company incorporated some of those ideas into the DC-1, DC-2 aileron arrangement of the balance, so they had some slot effect, and it was quite effective. This has been carried out for some years in the Douglas family of designs.

Most all of the engineers used to get their ideas from each other, or by experience. In '29, in the summer,

I got a wire asking me if I was interested in going to Europe to work for a European aircraft company, and if I was, to call somebody in Washington, a Navy commander. The wire came from a professor at the university I'd gone to. I telephoned and said I was interested. I was a bachelor and interested in going places and seeing things, and Europe was intriguing, and at that time Europe was supposed to be very far ahead of us in aeronautical design, manufacture and operation, because there were airlines in Europe flying at that time. The Paris-London flight was routine. In the States, anybody who went anyplace on an airliner considered it a novelty -- why waste your time going that way, when you could go just as fast by train?

The result was that Dr. Ernst Heinkel was in New York, and interviewed me. He had lists of possible aeronautical engineers to work for him in Germany. He wanted only one, on an airplane that he wanted to sell in the United States, under license. In the previous year, 1928, a number of German companies had sold licenses to the American manufacturers. These airplanes didn't prove to be quite satisfactory for the American market, as they were designed with more hand labor and less machining. The ideas of airworthiness, which were quite empirical, differed. I had been doing

stress analysis at Balanka, and also I was doing some stress analysis at $300 an airplane when I was working for Aviation magazine. (The period when I was with them was before it was sold to McGraw Hill, 1929, and I continued to write for them till 1933.)

The result of the interviews with Heinkel was that I went to work for them. He had gotten lists from the Department of Commerce, which later became the Civil Aeronautics Authority, of engineers who had experience putting airplanes through airworthiness procedure, stress analysis, flight tests. At that time, it was quite different from now; engineers are in short supply and the government would never think of giving a foreigner a list of American engineers that he might hire away. He would not be very popular. But at that time, there weremany engineers for every job, and nobody would ever think twice about the ethics of it, because it was giving an engineer an opportunity. So they gave Dr. Heinkel a list of engineers, and so did the university, and my name happened to be on both of them, because I'd had some manufacturing experience in my earlier days before I was in aviation. So they hired me. They also hired a Swiss boy who had ~~ag~~ graduated in aeronautical engineering the year after

me, who was working at the Ford Company in aviation.

With Heinkel, we decided to build an amphibian. I was influenced by the fact that ~~Belanka~~ Bellanca had built a six-place high wing monoplane, and it had been successful, and there was a market for them, and they were growing up all over the United States. Travel-Air and Stinson and Ryan and many others were building airplanes of that type, and there was a good market for them. Fokker ~~Balanka~~ as well. Most of them were high wing, externally braced airplanes. Fokker's ~~Balanka's~~ was a cantilever. (I went to work for Fokker after that)

So I worked for Heinkel and built a six-place amphibian with a Pratt-Whitney engine. When we were about ready to start the actual fabrication of the airplane -- the design was done, and we'd made tests in the water channel on the hull design -- Heinkel hired some engineers from the Rohrbach ~~Rohbach~~ Co., and they said that the hull design we had, hydrodynamically, ~~hydrodynamically~~, wasn't very good. They convinced Heinkel that we ought to change to their type of design, so without doing any further testing, we just threw ~~flew~~ everything over that we'd been working on for months, and put their form on the bottom, as they suggested. The fellow who made the suggestion was a structural man, not a hydrodynamic man, and he got the curvature back end to -- the part that

had the concave surface, he put in the front, and a flat portion in the back, the reverse of the way it should have been. The result was that when we went to take off, the boat just put its nose down deeper in the water and wouldn't get off.

We had only made one. So we modified the airplane by putting another false bottom on it, with modified hull, which was limited by the form that was available before, and we ran a whole series of tests and came out with a very good hull design, with the result that everyone was interested, because no one had ever done a full scale testing of flying boat hulls where they changed it and then flew it again. It was all done in the water channel, with the false bottoms. We had a waterproof bottom, and then we had another one under it which had holes in the back to let the water out.

At Glenn Martin, where they were just designing flying boats for Pan-American Airways, called the Clipper, they asked me about this, and they decided to copy the little low-wing floats on each side which were shaped like a wing called a sponson (?) that Dornier (?) had, and they copied the design -- or, I gave them the principles of it -- and they used it: a concave hull that was a modification of what we'd learned from Rohrbach.

An incident of what was going on at the time -- the way this group of engineers happened to come to work for Heinkel was

that Rohrbach had gone bankrupt. Roharbach was building airplanes for the Germans, who , under tne Versailles Treaty, couldn't build any military airplanes,but they could bu'id commercial airplanes for stunts, and a transocean airplane-- they built a flying boat; they had a flying boat built with compartments, a door in each bulkhead, so if a section of the hull would sink, it was divided into a number of watertight compartments so if a leak occurred it wouldn't sink. They were getting ready to take off for the flight across the Atlantic, and the radio operator was in the back, and they hit some floating debris in the water, and stove a hole in his compartment. The boat was moving along, accelerating, getting ready to take off. He opened the door and went forward, opened up all the doors, ran up to the front, because he had no way to talk to the pilot by radio or wire, to tell the pilot that there was a hole in the bottom. The pilot excitedly -- rather than take off and close all these doors and then land, though he was practically airborne then -- closed the throttle and settled down on the water, and all the water came in and all the doors were open, and the boat sank.

Then Rohrbach got another one to build, and they had taken the precaution of having fire extinguishers at each engine, but under the vibration of running the engines, the

fire extinguisher fluid emulsified like butter or cream, and they had a fire in one engine, and when they went to pull the fire extinguisher, nothing came out. It was solid. And they lost the airplane to the fire.

So, they had to lay off all their people, and that's how we got that crew of engineers from Rohrbach.

I went to Germany on a contract for one year, and while I was there I wrote for Aviation, and the Junkers family built a four-engined airplane with deisel engines embedded in the wings. Junkers advocated an all-metal, low-wing airplane, and published a book some years after this on the subject of why an all-metal airplane is safer. I got the book from a fellow who represented Junkers in N.Y. at the time, Robert Sherer, who is now in the business of making pills in Detroit, and does a very good job for all the pharmeceutical companies. The Robert Sherer Co. in Detroit.

Junkers had a pilot by the name of Fred Melchior. I don't know what happened to him, I've heard he's alive around the United States. Junkers built this large four-engined airplane that I described for our American press, where the wing was so thick that people could sit in the front of the wing, the leading edge, in front of the front spar, between the end-borne engine and the fusillage and have a fine view, and it was delightful. The airplane was bigger than anything that had ever been built at the time. The four diesel engines

took a lot of fuel, and the engines as I mentioned were inside the wing, and the propellers were located in what later was learned to be an optimal position, by a remote shaft to an gear-box with a clutch in back to dampen the vibration. Some very advanced innovations, that is, innovations which were advances in the drive shaft, which were engineering advances in vibration damping. Later some of those ideas were used in machine tools. One of the major machine tool companies today has a whole line of products around that idea, which I don't think they got from him, but developed separately.

The airplane was so big for its time, though it wasn't very big by our present standards, that its pilot on its first flight was concerned about how to know where the ground was. So they had a great long bamboo pole, about 12 feet long, on the underside of the fusillage, a foot or two from one end and the balance of it sticking out, and it was fore and aft right up flush against the fusillage. Then a spring could pull the long end down, which was sticking out behind, so that on landing, just before the pilot was ready to touch down, say 10 feet off the ground, he would release this spring, and the end of the pole would drag on the ground. The short end protruded up through a slot in

the fusillage, and sticking up from that was a bobber that he could see. This bobber would bob up and down, and he could tell when he was touching the ground, and as the bobber went down he could see that the other end was rising, and he knew where he was. There was a mark on it so that he could see when he was ready to touch, and when his wheels were ready to touch he'd close the throttle.

It's very interesting that some of our Air Force people, around 1950, proposed the same idea. I think they call it the "stick and feel 'em" principle. It still has some merit. It's a little bit simple and Rube Goldbergish for some of our people who like to use electronic devices.

Q: Did you work on airmail ships at that time?

Mock: I went to work for Heinkel. He was in the United States because the German steamship line that ran the Bremen had made an arrangement with a German airline called the Lufthansa for an airplane to be put on the two ships that were being built, the Bremen and the Europa -- the Bremen was the queen of the Atlantic for the first two years, till the Europa came along, its sister ship -- they put an airplane on the deck, on a catapault, and a day or two out of sea away from its destination, they would catapault the airplane off and the plane

would fly to shore with the mail, and get the mail to shore a day earlier than it could be done by steamer.

The Bremen cut the transatlantic time down so that they were making the trip in about five days, and this plane cut the time down to four days or three and a half. Because the transatlantic route was a great circle -- they followed the New England Coast -- later they found that rather than go in at New York, they could take off further out at sea and fly in to Boston, which was nearer as far as the airplane was concerned but still farther away from its destination, and then the mail would be put on the old American mail service, the old colonial airlines that flew down the coast at that time.

Q: Was the U.S. government easily convinced to take this?

Mock: They weren't concerned. They had no interest in it. We weren't doing anything in the field. We didn't have any decent transatlantic ships at the time. Our United States Line best ship at the time was the America, which did it in twelve days. It was a better means of communication, so far as we were concerned.

Heinkel came over on the Bremen on its first trip, in the summer of 1929, and while he was in the States, he decided to stay there while the trip made one round trip back to Germany and then go back on the second trip. During that

time, he got this idea of building an airplane in Germany. Heinkel had built the catapault and the airplane. It was a twin float long-wing monoplane, mail plane. So they hired me, and I went back after that, left in about September. While I was there, they built the catapault of a new airplane, with an American Pratt-Whitney engine, for the Europa. While the Bremen and Europa were in port, the airplane would drop its mail in Bremerhofen, Bremen, and then fly to the factory in a town called Verna-Linda (? ?) which is now in the Russian zone, where I was living. We overhauled the airplane and serviced it while the ship was being serviced. The ship stayed in New York only overnight, as a rule, but it stayed in the European port for a week. That was a regular transatlantic mail service for some years. The mail took 3½ to 4 days, depending on the time of day, whether it was the U.S. or the European coast, It depended on the time of day because they did not like to fly at night. They had no facilities. It was a seaplane. They would land it in the harbor and deliver the mail right there.

I also worked on this high wing amphibian, which was not significant except that it was an all-metal airplane. I left there when the Fokker Aircraft Co. of America, which was at that time owned by Mr. Fokker, General Motors, and a lot of other stockholders (of which Fokker and GM were the two large

stockholders). Mr. Fokker had a Dutch company as well. I was hired by Fokker to be the liaison between the American Fokker Co. and the Dutch Fokker Co., because they were building airliners at the time -- this was the 1930-31 period -- and I was going to leave Heinkel, because I'd finished the project I was on. I got acquainted with Fokker because the Fokker Co. was going to build the airplane that Heinkel had promoted, and I was project engineer -- a high-wing amphibian, which was successful. It was the first European airplane to get an American airworthiness certificate.

We processed the whole thing, and tried to sell it to the U.S. Fokker was interested, but the Depression was getting bad at the time and there was not much market. The idea was to sell the airplane in the United States, by making the hull and some of the parts in Europe, and assembling the thing here with American engines, equipment and testers, and selling them for 18 or 22 thousand dollars, ~~which~~ At that time the high wing monoplanes of ~~Balanka~~ Bellanca, Stinson, Ryan were selling aroudd 15 or 16 thousand, so for the three or four thousand more we could get an amphibian, and amphibians at that time were unavailable.

Just after we finished it, Drummond came out with an amphibian which was a high wing twin-engined job. (off tape)

I might go back and throw in a couple of things -- I might go back over some of the philosophies and people I came in contact with up until that time:

Of course, during the time I was with Aviation, I was going around and interviewing people all over the whole country. I got a very comprehensive feel of the general history of all of these companies, and naturally got to know the people and I've followed them ever since.

At ~~Balanka~~ Bellanca, Mr. ~~Balanka~~ Bellanca was a very ingenious man and very resourceful. His ability to create new things out of his own head was remarkable. He had some techniques which were very interesting. If he wanted to make a new overall design, he would draw three drawings where the span of the wings were about once inch, on the theory that he could see the whole thing without moving his eyeball, and gain comprehension of it while he laid it out on the table. The normal way of making a layout would have it as big as the table-top. You had to move around, and you couldn't get the perspective. After he got this done, with very fine lines, he would draw it maybe up to five or six inches of span, keep modifying it, keep on increasing the size, and as he did it he would fair in the lines and make sure of smooth curves on all the various sections.

He made the planes, where the surfaces of the body would

intersect a flat plane, so that he'd draw that line and see that it was a smooth line. This was very good, and it became a technique that many of us used for years afterwards.

When we began to get into airplanes the size of the DC-1, 2 and 3, then we began to use what they called lofting techniques, which were copied from shipbuilding, where they laid out the whole design on the floor, and did it by intersection of planes -- descriptive geometry.

~~Balanka~~ Bellanca also used the same philosophy in trying to discuss a problem. He would exaggerate it. He'd magnify it, to observe the increase in size, or minimize it to microscopic size, and try to analyze the problem at both extremes. You'd get a better understanding of it than you would be distorting the proportions of it as you saw it. I find this applicable to many kinds of problems in building and other things.

Also he had a philosophy of looking at something from the other end, backwards. Somebody would be looking at it from the front end, and he'd look at it from the back end and see how it would look. He'd look at the back end of an airplane, in the old days, and find some of them were not as good looking and well-designed as if you looked at the front, because everybody looked at the front. He'd turn them upside down and look at them -- if the bottom side wasn't as

clean, the air didn't know the difference while it was going over it.

This applied to many business problems, technical problems -- problems of life, too. It gives you a little bit unusual approach.

I came to work at Fokker in Holland, stayed there a little while, and went back to the States. I was assistant to Mr. Fokker. He was a very unusual man; there's a book, Flying Dutchman, that a man on the New York World-Telegraph wrote. I had two autographed copies around, that friends of mine have borrowed -- I'd like to get them back.
Tiffany, a man who lives at Annapolis, could get you a copy. There are a lot of very interesting anecdotes in that book, about Fokker's life. Incidentally, there's a book on Heinkel's life, too, published in English, in America, and in German and French. I've got three of them home, the French one; the American and British are somewhat different.

Mr. Fokker was a very intent man -- intent on any situation that was before him, and he was interested in technical things more than in anything else. His sense of values was different, from a monetary point of view. I recall one time we were on a boat, and we were going ashore for dinner, and we were going to buy some provisions for the boat.

We were driving along the road. (I must tell you that Mr. Fokker had become a millionaire before he was 21, through his own efforts, though he had some backing.) He was a man who had a very keen perception of what a piece of real estate or a piece of machinery was worth, or a vehicle -- if it was $10,000, he'd know. But he might be quite far off on what a pair of shoes was worth. An example of this -- we were driving along in the car, and I saw a sign that said, "Fresh corn, 25¢." Fokker was in the right hand seat. I was driving this old 16 cylinder Cadillac, which used more gasoline than we could pump in at a gas station -- if you left the engine running, I don't think you could fill the tank. He said, "Let's get some," so we stopped.

The girl asked me what we wanted, and I said, "Oh, give us a dozen." Fokker gave her some money, and she gave ~~¢/¢~~ him some change, and he said, "You made a mistake." She counted the change again. Well, he thought the corn was 25¢ an ear, rather than 25¢ a dozen.

I remember another time when Fokker invited some guests for dinner. It was hot summer in New York, and we had the boat at Englewood Basin, across from 125th St., NY, on the Jersey side. He invited the Governor of New Jersey for dinner, and we all looked forward to being out on the water

where it was cooler, and also, moving, we would still be cooler. They were going to join us a round 1 or 2 o'clock, and then we were going somewhere where the weather would be much better than it wasunder the windbreak of the Palisades.

While we were waiting for the governor to arrive, Mr. Fokker was running around the river there in his speedboat, and he saw man in the yacht basin with a little boat that was afloat, at anchor, and he was working on the engine. Fokker went over and began to talk to him and asked what he was doing, got curious, wanted to help -- finally he tied his boat up and climbed in there. When the governor arrived, some one else picked him up and put him on the yacht. We went over and told Fokker he was there, and he said he'd be there right away. I think about five hours later, dinner should have been served, we were still at anchor, and Fokker was still there, all greasy, working over this fellow's engine, which disgusted everybody. This was a typical thing.

When he was demonstrating his trimotor airplane, to try to prove a point that the airplane would not stall -- though actually he'd built it so you couldn't move the control surface to make it stall -- it was stable, it would go up and finally settle down again, but it wouldn't fall off to either side. Fokker used to take up a whole bunch of people, most of whom had never been in an airplane before,

and he'd take the airplane off, and then after they were flying level, he'd get out of the cockpit and come back in the cabin and sit down and talk to them. He'd talk in a very relaxed manner, discuss all kinds of things -- it was quite an act.

Fokker had a great intuition for aircraft design, and scoffed at theoretical engineers. We built an airplane, a flying boat, with wheels, which was called an amphibian. It had a tail skid rather than nose wheel, two wheels with a skid in the back. They were just about ready to fly it when Fokker one day called the chief engineer (Gaster, who was chief engineer at Fairchild, now dead) and said that he thought that the structure that supported the tail skid was not strong enough and would very easily fail on the first landing. The chief engineer said he'd check it, and came back the next day saying he'd checked it and it was good enough. He (the engineer?) Fokker insisted, and took the data all home and checked all the stress dimensions, analysis and calculations. The engineer insisted it was all right. Then Fokker went over to the airplane and got hold of one of the struts, way back on the tail, lifted it off the ground, shook the airplane, and his shaking of this weight of that big lever broke the structure and the airplane came down on the concrete floor.

This was typical of him. Another time, the Ford Company

decided to have a tour around the United States, which they did for some years. They had this tour every year, where they used a formula based on gross load and flying speed and all that, to determine the motor efficiency of an airplane. These airplanes would fly from Detroit south, to the East Coast one year, the West Coast another year, then north and back to Detroit, a tour to measure their performance, and one of the airplanes would win a prize. Itwas a great prestige thing, especially if you're trying to sell airliners.

Ford announced a change in the formula, and Fokker saw that if he took his old F-7, which was a single engine airplane, and added two more engines and made a trimotor out of it, he came to the conclusion that a trimotor could do it. How could he get a trimotor in a hurry? He decided if he put two more engines on his present airplane it would have a good chance of winning the tour. He wired to Holland, where they were building the wings and fusillage, and assembling them in New Jersey, and told them to put the tanks and engine mounts on the wings for two engines, in such a way that they could clear the propeller and wouldn't touch the fusillage. This was before the transatlantic telephone -- it was by cable, and later he wrote a letter. Then while they were designing it, they were making the engine mounts and the whole engine arrangement in New Jersey, for the two engines which were supplied by the

Wright Company -- two Wright Whirlwinds of 200 horsepower each. There was a question of the collector ring, which was a great big annular ring, about five feet in diameter --like a doughnut -- and it collected the exhaust, which all went out one tube which was called the ? This had to be welded, and welding techniques in Holland were much better than in the States, so they decided to have it made in Holladd. Fokker went over there about that time to see how the thing was progressing. They were getting ready to ship the wings and fusillage -- no, I guess the fusillage was built in the States. Fokker decided that he would take back the three collector rings, and they wrapped them up in burlap, and they looked like three great big doughnuts. He took them to France, then got on a boat and crossed the Atlantic. Going from France, he declared them, and facetiously -- he was very prone to be facetious -- he declared them as musical instruments and said he was a musician, and they could assume they were French horns if they wished. When he got to New York he did the same thing and everything went fine. He brought them into the U.S. without any fuss. Now, the duty wasn't very much, but aeronautical products attracted so much attention that they were always delayed.

I was with Fokker for ten years. I left in 1940, and

I came with Lear, and I've been with Lear ever since.

Q: What would you say was the most significant thing accomplished while you were working with Fokker?

Mock: The most significant thing was the fact that Fokker -- I proposed to Fokker that a metal airplane, which Fokker was designing to replace their wooden airplanes as a transport --and I must give you some background: Fokker's company was the largest manufacturer in the world of airline aircraft at that time, around 1932-33. Fokker was building airplanes for nearly all of the world's airlines, building them not only in his main plant in Holland but under license in many other countries. I think he had some 25 or 30 licenses for the single engine airplane and about 15 license s for the multi-engine airplane. The Fokker Co. of America, which later changed its name to General Aviation, and still later to North American Aviation , was one of the affiliated companies.

The Dutch company was building a metal airplane, a t the same time as TWA had a competition in the United States in which the American Fokker Co. (which Fokker was then out of, which had changed its name to General Aviation/ as General Motors controlled it) -- General Aviation and the Douglas Co. were in competition, each building an airplane to meet

specifications set up by TWA.

The Boeing Co. had already delivered an airplane called the 247, which was a ten passenger low-wing monoplane. That is a carryover from the Boeing monoplane. The competition ruled in favor of the Douglas Co., which had made more progress and was a better organized operation, and they finished up and made a good airplane, the DC-1.

As soon as I saw pictures of it and learned something about it, I proposed in the summer of 1933 to Mr. Fokker that we were designing, that we rather than proceed with the airplane we were designing, take the European license and build this airplane under license to the Douglas Co. and sell it.

He and I came out to see Douglas in September, 1933, and Mr. Douglas felt --or the general manager felt -- that there was no market in Europe, that we were crazy; that he couldn't sell American airplanes in Europe, the Europeans were going to use their own. Fokker recognized that the tooling and investment in a metal airplane was quite different, and there would be less for a license manufacture. We bought the license rights and the sales rights for Europe for $100,000. The Douglas Co. was not very well off from a cash point of view, and under the selling rights arrangement, we would buy these airplanes from the Douglas Co. in the U.S.,

take delivery here, so the Douglas Co. had no export problem. We would pay cash when they delivered the airplane. There was a period there, for several years, when we were the largest customer the Douglas Co. had, because the European market began to open up. There was great difficulty in selling each of the European countries on the idea of getting an airplane that was manufactured in the United States, so far away. There was no transatlantic flying then. Spare parts, support, lack of acceptance, the question of whether the American airplane structure was good enough, aerodynamically good enough, whether it was airworthy. . .

I represented the Fokker Co. in the United States, and I worked with their sales department in supporting them here, and I moved my offices to the Douglas plant during the negotiations. But I stayed there, at the Douglas plant, for seven years, buying airplanes from them, supporting our people, trying to anticipate where the markets were in Europe, speculating, under Fokker's authority. He authorized me and I bought airplanes from the Douglas Co., and we equipped -- the first major airline that had the courage to do it was the Dutch airline, KLM, the Royal Dutch Airline, It had a Douglas DC-2, bought under through this arrangement, that was in the McRobertson race, from London to Australia, in 1934-35.

That airplane was the first Douglas plane in Europe. It was the first American transport in Europe. United States TWA was just starting, the others were looking askance at Douglas, at Americans operating a twin-engined airplane called the Condor that was a carry-on of the general arrangement of that old trimotor transatlantic bomber that I mentioned earlier. No: The Condor came out of a Curtiss bomber that was built by the Keystone Co.

The European airlines were government supported, locally, and it was not easy. The Dutch won out because the Dutch airline was very very successful and had a great deal of influence with their own government. Mr. Plasman? who was the founder of KLM had the foresight to see this. The Dutch had disagreed with the airworthiness structure of the Douglas DC-2. The Douglas Co. was very confident of their own ability in this field, and looked askance at this young boy that the Dutch had sent over here, Professor who questioned whether the airplane structure was strong enough. As a sap, to get them off their back, they agreed if we would pay for it to make some changes -- to change the rivet arrangement around the windows and doors, the structure of the tail -- they made four changes. The wing attachment was one of them. It was very interesting that within two years, the American airplanes which did not have these changes

began to have failures at all of these points. Pan-American discovered the wing-attachment was cracky and grounded their airplanes. American did the same thing. They copied and used the design that this Dutch boy had forced Douglas to use.

Q: But at the time when the Dutch boy demanded the change, the people at Douglas --

Mock: --Just laughed at him, yes. So it proved that it was not the size, it was a corner on brains -- that a young boy could come along and make a theoretical analysis, and pick out four points in this great airplane, that was acclaimed the world's foremost vehicle, and had been tested more than any other airplane had been tested at the time -- that he could pick these points, and prove correct. I don't remember that young man's name now, but we can get it. Get hold of Mr. Vandermoss, who is chief engineer at Fokker in Amsterdam now -- in fact, he was involved in doing the stress analysis at the Dutch end of it. He was in the stress department at the time.

Q: So you came to Lear in 1940?

Mock: I was with Fokker during this time when we took on a representation not only at Douglas, but at Lockheed, North American, Vultee, and Consolidated. When Lockheed was competing with Douglas, we dropped out and stayed with Douglas alone. The program snowballed and moved into the DC-3. We sold 114 airplanes all over the world, mostly in Europe, during the seven years. Then I left there in 1940, when Holland was invaded by the Germans so there was no longer a company. Officially there was no longer a company. It was operated and run by the Germans.

I came to work for Lear. I was a little bit fed up with the ups and downs of the airplane manufacturers. It was always feast or famine, and I decided I would get into the aircraft equipment business, selling equipment to all of them, and I wouldn't have to worry about which one was on top. Lear was a radio manufacturer, just getting over into the field of making some of the equipment that was developed for remote operation radio, mechanical devices and other devices they were applying to airplanes -- accessories for moving cowl flaps, moving doors, wing flaps, things like that. I started out like any other.

Q: Would you tell me something about the contribution of this to aviation?

Mock: I think first the promotion of electromechanical devices, as aircraft equipment, which meant that we had the flexibility of recognizing that if a device is operated electrically, the controls that operate it would have a flexibility and the possibility of being mixed with other controls, so you could have a multiplicity of functions and operate a whole system electrically. That would be hard to fix up, and it is, but still they do it -- mix electrical and hydraulic, electrical and pneumatic, electrical - mechanical.

Bill Lear, in his basic approach to aviation, was always thinking of what he could do to improve safety under all weather flying conditions. Towards that end, he began to get into islams and into automatic flight control. The automatic pilot that was conceived by Mr. Lear started during World War II, when they were bombing Berlin. The fighter escorts accompanying the bombers were operated by a single man, and he arrived over his target pretty well fatigued, compared with the bomber crew who could relieve each other. So the military wanted to get autopilots with relief flying devices, and we started to work on this, but the war was over before we could get anything done. I was chief engineer for the company, but we were making mostly motors, activators, mechanical devices. We'd dropped out of the radio business.

From that beginning we developed the autopilot, and couldn't find the kind of gyro that we wanted, and Mr. Lear and his people developed their own gyros. When Wright Field went to evaluate the autopilot, they took the gyros out and had the instrument group, gyro group, evaluate the gyros, and found they had better performance than the gyros they were using in their flight instruments. The gyros were operating into an electronic amplifier which could operate something remotely, and could operate the flight instrument remotely, so we got a contract for making remote-operated flight instruments, actuated flight instruments where the gyros were separate, and the high performance gyro --much higher performance than you could put into an instrument where the gyro was mechanically operated, as you could amplify the signal.

This resulted in the vertical gyro indicator of a type which had all kinds of flexibility, as to its presentation, and was not limited by the mechanical interconnection with the gyro and the indicator. The result was that all the military aircraft in the United States now use this -- practically all the aircraft, most of the aircraft -- use this type, and we've made most of them.

The autopilot continued on. When Mr. Lear recognized the missile trend in the forties ('46, '47), he decided to change the

autopilot so he stopped the whole program, even though we had production orders, which took a great deal of courage and was very dramatic, and said, "Before we start, let's changeit to a fast response which is suitable for things to come."

He conceived and worked out the whole thing. He got it built and tested in about thirty days, all the changes necessary, which shook Wright Field, and the result was that we had an autopilot suitable for both missiles and high speed aircraft that were coming, and the net result was that we had a basic autopilot which is still modern today, and put us way ahead. It gave us a great flexibility, because our competitors were always putting patches on their autopilots to make them do things, while our autopilot apparently could do them.

Well, the autopilot was a great contribution. Flight instrument presentation was a contribution. Mr. Lear received the Collier Trophy, for the autopilot and flight control. Also the autopilot tied into what you might call the approach coupler, which locked the autopilot on to radio landing beam, and we could use this for all-weather flying, in the F-86 airplane, F-86-D with North American. We've sold six or seven thousand. It was the first all-weather interceptor, and it was also a new type intereeptor, in that they only had a single man, while all other all-weather aircraft

had one man to fly the airplane and one man to operate all the electronic gearand controls. This had the airplane fly automatically and the man ran all the flier controls. This was possible only because of the superior autopilot.

. . . the accident that resulted in ~~Low Doctor's~~ Knute Rockne's ? death. This was when I was with Fokker, 1931, I guess. It didn't result in any advances in aviation, but it /just/ did focused attention on the fact that pilots were making decisions which maybe they shouldn't.

The circumstances of that accident were that a mail pilot, flying mail alone, landed in Kansas City and looked at the weather reports and decided to cancel out. A TWA pilot landed and looked at the weather reports and decided to go on to Wichita. The mail pilot, hearing this, took off after him. The airliner never got there, and the mail pilot did. The mail pilot said it was the most harrowing flight he ever made in his life. The airplane iced up; he went south, to get out of the area; and the ice broke off. He iced up and he couldn't see as well. The TWA airplane crashed.

Q: How did Fokker come into this?

Mock: Fokker had built the airplane, and there was an

investigation. It was a question if the airplane had structurally failed in the air, and it was determined that the airplane was not properly made -- there was sawdust in some of the glue joints. However, later we learned that the airplane was more than strong enough, that you could pull an airplane apart under the circumstances. In the investigation, for instance, they found on the ground a mailbag and over it a piece of wing -- a big piece of wing, as big as a tabletop. Well, they knew that a mailbag falling out of an airplane will fall straight down, and a wing will flutter around like a piece of paper would. The fact that they were in this arrangement on the ground indicated that the mailbag fell out of the airplane before the wing came off. The wing couldn't fall under the mailbag. So it was evident that for a mailbag to fall out of an airplane, the airplane must have been ~~at~~ in an unusual attitude because the mailbag was under the floor under the pilot's seat. The airplane had to be either in a dive or over on its back for the mailbag to fall out through the window or one of the doors.

Q: Which put the blame on the pilot rather than the plane?

Mock: Well, it put the blame on the pilot. First, he shouldn't have been there --he couldn't fly instruments -- or, the ice was such that -- we don't know. He couldn't have flown

the airplane under that circumstance. Then, putting an airplane like that in a dive and pulling it out would structurally tear it apart. But the airplane at that time was condemned by the public and the aeronautical people, and they stopped building wooden winged airplanes for transports, because they put such restrictions on their inspection, their maintenance and everything else . They continued to fly them, but it was a nuisance.

So it was an advance, but at least internally the people that were inside the investigation knew that pilots should give more credence to the weather reports. We saw the weather report afterwards. The wind in Wichita and the wind in St. Louis and Kansas City were blowing in opposite directions, and he was going to fly between these two points. Well, you knew there would be severe turbulence where those two drafts of air that were moving towards each other hit.

Q: Is there anything else you'd like to say about Lear?

Mock: Lear has for many years been working on all kinds of advances in flight safety. We feel that the airliner that has multi-engine, multi electrical system, multiple hydraulic, multiple wheels -- any of the multiplicity of radio -- should have multiplicity of auxiliary flight controls or primary flight controls such as the autopilot. If you had two of them,

and there's one system that has two of them where they're fastened together and if they're not in agreement, it shuts the other one off -- shuts them both off -- which is like having a two engine airplane, and if you have one engine stop, it will shut the other one off ~~two~~ too. Also, it's like waking up in the middle of the night, if you have two watches, and one of them's an hour off from the other and you don't know which one to believe, they're both going. So we feel that a multiplicity of autopilots, three or more, is necessary. And because time is moving so fast during landing, or any critical position, that the pilot wouldn't have time to decide what to do, the selection of the element of an autopilot, leaving the elements of the ~~other~~ remaining two or more, should be done automatically. This is a significant advance.

Another device is our instrument called Life, which is a blind flying type of instrument which presentsto the pilot the attitude of the airplane, whether it's flying in a natural manner, which we call Lear integrated equipment. It's a type of presentation of the instrument in a natural manner. The instruments that were made before had a presentation to the pilot which depended on the fact that the gyro in the old World War I carry-out type, the gyro was mounted right in the instrument indicating case, and mechanically the way the gyro moves

the instrument had to read in an unnatural sense or backwards from the way you would expect. People trained themselves and learned to fly with it backwards. It's like the difference between the steering wheel of a car and pushing the handle bars of a sled. You push the handle bar to the left to go to the left, you push the steering wheel to the left to go to the left, but there are some vehicles whereyou do the opposite.

The electrical remote operation of the gyro to the indicator gave us a flexibility where we could just reverse the leads and make it run a natural set. With the first instruments we were making, I'd been running them the same way as all the other military ones because the people were trained that way. But Mr. Lear equipped one with an instrument going in the natural sense, and made the presentation that it was easier to follow. You could read it without any training. You could understand it -- you make two things line up and you move something until two pointers line up. Or a bar lines up or something. Mr. Lear is around, if you want to see him. He'll be in the States until the end of the month. Get hold of Jim Shields and tell him what you want.

Bert-

Verne Balchen was the pilot who flew Byrd across the Atlantic, the same year Lindbergh flew over, but later. He flew the airplane. He also flew Byrd across the South Pole.

He was with Byrd on the North Pole expedition. I was working at Fokker when I heard a story about this. Balchen was a man who'd lived in the Arctic, an outdoor man, and the boys at the plant were going hunting, looking forward to and preparing for it the deer hunting season/for months. The day they were leaving, Frank? the plane?came in for flight tests. He was test pilot for the company. They asked if he'd like to go along with them. "Sure, where are you going, when?"

"We're going tonight."

"What do I do?"

"We'll pick you up at your house."

Well, the time came, and they were all in their hunting clothes and had their equipment with them, and they Bert's rang ~~his~~ doorbell. He came out in a business suit, no overcoat, no gloves, hat, with a gun -- no case for the gun -- and got in the car. "Where's your gear?"

Well, they went off. You were only allowed one deer per person, and every time they'd think there might be a deer someplace, they'd hear a gun go off, and a deer would fall ~~follow~~ over, and Balchen's gun would be smoking -- and he got one deer for everybody in the party, one shot each deer.

They asked him about it, and he said, "Well, when you live in the Arctic and you see game only once a month,

if you don't get it on the first shot, you don't eat."

The aviation industry and the business has matured and grown, from being a bunch of mechanics and technicians who were trying to do something, working in an atmosphere where you had a bunch of enthusiasts immersed in the cause, into a business. And many of the people have evolved to the point where they have learned that they must run these things as a business in order to make them successful. In other words, a financial force and business management must go along with it, and the volume of money that 's involved in each of these projects has gotten so big, time schedules are so exact, what with the programs of other things that go into the same system, that if the timing is off, great sums of money are wasted.

Technically we must evaluate these programs as they progress, and we have learned to get into the area of what is called scientific management. There's been a revolution in the last thirty years. Successful companies are actually scientific managers; they run management on a scientific basis. Some of them get too scientific, so academic that they can't do anything for low costs, and they lose sight of what is practical. Take that example I gave you of Mr. Fokker and stress analysis of the flying boat. I left out the punch line of that. After the thing failed and they went back and analyzed it they said, "Oh yes, we found this part is the

weak member." Fokker said, "I knew that yesterday when it broke."

I think that this was a very significant thing, that the aviation companies have gotten to a stage of having such financial structure that they've got momentum where they're going to go on in other industries and other fields and apply these things, -- the technology of very fast response servo-mechanisms. Now, the servo-mechanism is a device that you can operate remotely, automatically you might say. They're getting industrial controls, organized processes, all kinds of other things.

The world is moving into a new era of technology which is affecting all industries. We went through an era in the last hundred years of having electrical machinery. It's become a very important part of our lives. The electric motor was the essence of nearly everything we had, whether it was driving a washing machine or opening a garage door. Now, with the transister, we can use much more concurrence to control these devices. In many cases, the old signal enunciating device, a doorbell circuit, heavy wire, the complex system is going to be eliminated, and things will be much simpler. All we need is a high power and heavy wire for the power needed. We also need for the aviation industry lighter and more efficient devices. People are getting more light-weight conscious. People in the aviation industry have learned a lot about

structures, cantilever structures, structure design. They are all conscious of bridge building, aluminum bridges, and the cantilever structure that you see in much modern architecture. People are giving more attention to those things. There have been cantilever bridges for years, but they were always within the conventional range. A cantilever bridge built 80 years ago looks like one built 200 years ago.

So you can see the advent of structural design, the advent of the aeronautical technology and servo-mechanisms and all kinds of controls, and all kinds of military electronic devices, and the business management aspects of the thing, all adding together to have an impact on the way things will be different tomorrow that might be conventional today.

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