

Contrails

INTRODUCTION

**Major General L. I. Davis
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It is a pleasure to be here today, especially because I see so many people in the audience. I am very surprised to see such a large turnout. I hope that most of you are here for the same reason that I am, and that is to learn something of the background of this effort in adaptive control systems. In my former tour in the Headquarters of the Air Research and Development Command, I put a lot of emphasis on automatic controls, control systems of various sorts. In coming back to the Headquarters again in August, I requested some information about the progress of the research in adaptive control systems, and perhaps this group this morning, who are going to meet here tomorrow also, will be able to educate Davis.

My interest, of course, stems from the very fundamental relationships that exist in all our military weapon systems. I like to use the analogy of the three-legged milking stool with the seat representing the warhead; one leg representing aerodynamics; another leg, propulsion systems; and the third leg representing guidance and control. Without any of those three legs you don't have an effective military weapon.

You all know, of course, of the tremendous amount of emphasis placed on aerodynamics, the billions of dollars that are invested in wind tunnels, space flight rockets, and things of that sort. You also know of the billions of dollars that are involved in our propulsion systems, both in research and development, and in industry as well as in the service. It is my feeling that we don't have a corresponding amount of effort on this other leg of the stool representing guidance and control and including the adaptive control systems.

I did not see the last launching of the Atlas, the one that went into orbit, but I have been very impressed by the great degree of stability shown by our ballistic missiles in the initial part of their flight path. It is amazing to note the performance of the automatic controls, but this is just the first part of the flight, the part of the flight you might say, which is still under pilot control. The later portions are the more precise portions. Those dealing with putting something into orbit, or perhaps controlling it more precisely upon re-entry will require a much greater degree of sophistication and accuracy. I bring up this subject of the Atlas flight because in this instance, you are using a radio control system to guide it in trajectory. Although I was not there, it was reported by those people who did see the flight that one of the reasons it did not go into higher orbit was that the control system was rather sloppy. An appreciable amount of energy was used in the gyrations along the path.

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This is just an example of what still needs to be done in all our control systems. So far as adaptive controls are concerned, when you consider the wide range of acceleration, the rapid change of mass, and the wide range of atmospheric density upon re-entry, you see that a missile is a system that is pretty hard to prepare on the ground for all the necessary adjustments before the flight. It has to be self adjusting, or should be.

Another reason why we are very interested in this adaptive control system is philosophy. I think that before we get too involved in serious matters, I ought to mention a little story that Jimmy Doolittle brought back from Europe. It deals with a famous old circus over there, well known throughout Europe. One of its best acts was a tiger-taming act. This had been a good act for many years, but as all things happen sooner or later the old tiger died and they got a new young tiger that was very fierce and had sharp teeth. At the next showing, the young man stepped into the cage with his pistol, chair, and whip. When the young tiger saw him, he jumped across the cage and knocked the chair down, took a slap at the pistol and almost removed the tamer's clothes. The young tiger tamer backed out of the cage. This was very serious because it was a famous old circus and they had a great tradition. The show must go on and they had another performance in about two hours. So the manager called all the troopers together and asked for volunteers. There was a silence and finally a little girl in a Bikini bathing suit, who was in a tight rope act, volunteered. She was raised in the circus, born in a trunk and all that sort of thing. After some consideration they decided to let her go on. At the three o'clock matinee performance she stepped in the cage with a chair, pistol, and whip. They opened the other gate and in dashed this fierce tiger. She cracked the whip and he just sat there. She cracked the whip again and he went down on his stomach and crawled across the cage. He licked the girl on the toe, then he licked her calf, then her thigh, and he finally ended up with his head on her bosom purring gently and the crowd went crazy hollering "Bravo" and so forth. The manager turned to the young tiger tamer and said, "Why can't you do that?" The tiger tamer said, "You get that damned tiger out of there and I'll show you!"