16.

Jets—Early Possibilities, 1950–1953

The AVRO Jetliner

The jet project that first came closest to manifesting my conclusions—which Howard ultimately shared—was essentially a product of British technology, but it was developed on this side of the Atlantic, although not in the United States. The Jetliner, the first jet transport produced in North America, was an advanced, medium-range, 450-mph plane that first flew an amazing eight years before Boeing's 707. This extraordinary achievement is all the more remarkable considering that it was the first product of a new company in a country not dominant in the development or construction of aircraft. The design, developed by A. V. Roe Canada (AVRO), was conspicuously ahead of any competitive transport. The program represented a giant bite for any company to chew in 1946, when the project was undertaken, no matter how extensive its resources or how well qualified the individual participants.

J. C. ("Jim") Floyd, AVRO's chief engineer, was responsible for the design. He had contributed to the design of many famous aircraft produced

in England by the parent company, and he transferred to Canada when the project started. Jim's overall design goal was to achieve the best compromise between the conflicting requirements of short-runway and high-speed operations without sacrificing reliability and maintainability. The prototype Jetliner was a distinctive-appearing, low-wing, 30-passenger design with four engines mounted in two double nacelles faired smoothly into the wing leading edge, and with the horizontal tail mounted halfway up the fin. Its exceptionally clean lines gave the impression of aerodynamic efficiency.

The project was beautifully timed and appeared to have a rosy future. By the time of the first flight, August 10, 1949, the Convair and Martin twins were underway; the first Vickers Viscount had not yet entered BEA's experimental service; and all of them except the de Havilland Comet, which had flown a few weeks before, lacked the sparkling performance and exceptional comfort of the Jetliner.

Early on, Trans Canada Airlines (TCA) executed a letter of intent of its own construction for the conditional purchase of an undisclosed number of Jetliners. The conditions were tough. TCA was to furnish AVRO with detailed specifications for the design; the first plane had to be delivered within 30 months; a low estimated purchase price was stipulated with rebates to TCA from sales to others. AVRO, anxious to land its first customer, accepted TCA's demanding terms.

AVRO's deal with TCA began to unravel after Floyd's design was well under way. TCA had insisted on the installation of Rolls-Royce AJ-65 engines, and AVRO had inexplicably acquiesced notwithstanding unconfirmed availability. When E. W. Hives, later Lord Hives, of Rolls-Royce made it emphatically clear that the AJ-65's were on the military's "secret" list and could not be made available commercially for many years, extensive redesign was undertaken to install Rolls-Royce Derwent-5 engines at considerable cost and schedule penalty.

It became apparent as the design progressed that the purchase price stated in the TCA letter of intent was unrealistic and required adjustment. AVRO proposed an increase in price along with modification of a number of letter-of-intent obligations it considered onerous. The upshot was that TCA wanted out. A keenly disappointed AVRO acquiesced. After that unfavorable event, design of the prototype continued, but at a slower pace.

AVRO continued its efforts to sell TCA. In early 1948, after the design had congealed and construction was underway, TCA suggested compli-

ance with sweeping new design objectives, including a substantial increase in design speed. Acceding would have required complete redesign. Jim Floyd said later, "It would have been easier to convert a cow into a crocodile than to comply with TCA's new objectives."

The final act, which completely unraveled all prospects of TCA's becoming the launching customer, was Gordon R. McGregor's statement shortly after his election as president of the company: He did not want TCA to be the first airline in North America to operate jet transports. With that, development work was sharply curtailed.

As soon as the test program permitted, a series of record-breaking demonstration flights were made in Canada and the United States. The flights generated lavish praise in the press and captured for weeks the attention of the world aviation community. Buoyed by this success, the construction of a second Jetliner was undertaken.

With the loss of TCA as the first customer, it was clear that AVRO needed to mount an effective sales campaign quickly if the venture were to succeed. Attention was turned toward the United States. Among others, C. R. Smith, then president of AAL, was invited to visit Toronto to inspect and ride in the Jetliner. Smith accepted and brought along his assistant, R. Dixon Speas, who was captivated by the plane. Dixon was offered and accepted a position with AVRO as U.S. representative. Speas, on a year's leave of absence from AAL, with the help of Joe A. Morley, AVRO's sales and service manager; and Gil Dunkin, its sales engineering representative, brought the Jetliner to the attention of the key executives of all major U.S. airlines.

Dixon was soon able to report to Joe Morley that key engineering and operations executives at AAL, Capital, EAL, TWA, and UAL were favorably impressed with the plane's performance; and that George T. ("Ted") Baker, president of National Airlines, was prepared to negotiate a contract for 4 of the aircraft at $1 million each with an option for 6 additional planes. The Jetliner was also demonstrated to the U.S. Air Force and U.S. Navy. The Air Force was so favorably impressed that it considered ordering 20 for high-altitude navigation training. Ralph Golt, then head of sales for the Allison Division of General Motors, called Dixon Speas later and informed him that the Air Force deal was on with Allison engines, and one of the engines was being prepared for shipment to Toronto for tests. This serious U.S. military interest, along with airline interest, suggested that the Jetliner program was about to take off in a big way.

By this time the United States and Canada were heavily involved in the Korean conflict. AVRO was manufacturing in quantity twin-engine CF-100 fighters for the Royal Canadian Air Force but was behind schedule. The fighter program had top priority and had usurped personnel from the Jetliner program—a fact that almost stopped the design and construction of the second Jetliner.

The Right Hon. C. D. Howe, the Canadian minister responsible for such matters, was requested to approve an increase in manpower for the Jetliner program. Instead, he unequivocally ordered the project closed until AVRO got the CF-100 program back on schedule. Fred Smye, the general manager of the Aircraft Division, responded by terminating the Jetliner project and made Jim Floyd plant manager. In a last ditch effort to save the program, Dixon Speas maneuvered himself into a seat beside C. D. Howe at a Massachusetts Institute of Technology alumni affair in Toronto and endeavored to persuade him to review his program closure decision. Failing to persuade Howe during the dinner, Dixon slipped into the limousine driving Howe to the airport and continued his sales efforts. Just as they reached the airport, Howe turned and said, "Speas, haven't you ever heard of someone having too much on their plate? Well, AVRO has too much on its plate. We are committed to going forward with the fighter, so the Jetliner must go on the shelf—and that is that."

Howe's turndown appeared so definite that Dixon resigned from AVRO, but instead of returning to AAL started his own consulting business. With this development, despite strong airline and serious military procurement interest, this promising program became entirely dormant, a victim of the Korean involvement and improvident political thinking. AVRO knew the clear lead it held in jet transport design in this hemisphere was a perishable advantage that would disappear with passing time if the project could not be quickly resurrected.

I had kept Hughes advised of the merits of the Jetliner and program progress. Shortly before Howe's conversation with Speas, he had discussed with me in confidence his desire to manufacture jets for TWA and other airlines.[1] He asked for my opinion concerning the suitability of the Jetliner for airline use and my recommendations concerning design changes that might enhance utility. Without revealing Howard's interest in manufacturing, I undertook studies of several design variations of the Jetliner with the cooperation of Jim Floyd and Dixon Speas.

Howard and I debated at length the merits of the study designs. Capac-

ities ranged from 40 to 52 passengers. Power was to be provided by four Rolls-Royce Derwents or "cool" (reduced hot-section temperature) Nenes, or by two P & W J-57 engines. The 48-passenger Derwent and the 52-passenger cool Nene versions appeared capable of carrying excellent payloads at good operating costs on New York-Chicago and Chicago-Kansas City segments. The twin appeared capable of economic operations on the Chicago-Los Angeles segment, but the annual average performance of the twins would have been undercut somewhat by the higher CAA weather minimums (airport ceiling and visibility limits for takeoff and landing operations) required for two-engine compared to four-engine aircraft. We tentatively decided in favor of the cool Nene version, partly because it required less investment and could be produced considerably earlier than the twin.

Howard had a wonderful facility for selecting the most opportune times possible to express interest in potentially attractive ventures. This was no exception. When he heard the program was headed for oblivion, he adroitly jumped in with a double objective: the production of jetliners on his own behalf and the sale of Hughes Aircraft's MG2 armament fire-control system for AVRO's CF-100's.

It appeared the Jetliner might well serve both ends. First, the Jetliner seemed like an ideal test vehicle for the MG2 system because of its high-altitude capability and ample fuselage space for test equipment. Secondly, use of the jetliner by Hughes Aircraft would provide an excellent opportunity for Howard to fly the plane and study production feasibility. So, early in 1952, use of the single prototype Jetliner to test the MG2 system was suggested.

Crawford Gordon, Jr., AVRO's president and general manager; and Fred Smye were especially pleased with the prospect of demonstrating the plane to Hughes. They saw this as a great opportunity to work out a rescue operation for the precarious Jetliner project, if Hughes could be persuaded to produce them under license for TWA. At the first opportunity, Smye broached this subject with Hughes, which was exactly what Hughes wanted. Don Rogers, AVRO's chief test pilot, flew the Jetliner to Hughes's Culver City facility on April 8, 1952. Jim Floyd, Joe Morley, and a few others were on board. Fred Smye and Crawford Gordon had arrived in the Los Angeles area a few days earlier for opening discussions with Hughes.

Hughes inspected the plane soon after its arrival, spending most of his

time on the flight deck. The next day, after only one takeoff and landing by Rogers, Howard flew the plane, making numbers of landings. Almost from the first, he was completely at ease with the plane. After landing, he complimented Floyd on the plane's good handling characteristics.

During the next few months the AVRO executives played Hughes's customary waiting game, during which Howard made numbers of additional flights. Floyd and the other AVRO representatives were on call anytime night or day throughout this period. Floyd was initiated into the fairly exclusive club of all-night palavers with Hughes.

I flew to Los Angeles to inspect and make a flight in the Jetliner with Howard. We spent about an hour on the ground at Van Nuys Airport discussing and visually examining the plane, after which Howard put it through its paces for nearly two hours with Rogers as copilot.

The flight was smooth and exhilarating and reinforced my enthusiasm for jet power. During the flight, I made voluminous notes and sketches concerning detail design, the interior, noise and vibration levels, apparent ventilation rates, and other items of interest. I was standing in the center of the flight deck behind Howard and Don, hanging on to the backs of their seats, when Howard made the landing approach to Van Nuys Airport. The plane approached much too low at too high a sink rate near subminimal speed. Not a happy situation. Don abruptly but with a smile applied full throttle to increase the speed and stretch the glide. Howard did not object and landed at the very end of the runway.

After a few minutes on the ground with Don, Howard and I drove in one of his Chevrolets through Laurel Canyon to Hollywood with a side trip on Mulholland Drive, where we parked several hours to talk. We discussed the plane and my design studies, which I had summarized and mailed April 29. I gave the plane high marks but recommended further exploration of the use of engines manufactured in the United States to enhance sales, and the development of a stretched, high-speed version as soon as the market warranted. Then he dropped me off at the Hollywood Roosevelt Hotel.

Howard opted to manufacture the Jetliner and took exploratory actions. Because the enormous Hughes Culver City facility was jammed with flying boat and other pressing work, Howard turned to Convair, with whom we had had numbers of recent conferences concerning the development of long-range, turbine-powered aircraft. He suggested to Floyd Odlum a contractual arrangement between AVRO, Convair, Hughes Aircraft, and

TWA, which, contingent on CAB approval, would permit the early construction of Jetliners for TWA and ultimately for other airlines. Odlum responded by requesting Convair, which he controlled, to examine its ability to produce and sell Jetliners.

Convair did so, but the company was only lukewarm. It preferred to manufacture larger, longer-range, higher-speed aircraft of its own design. Convair, like me, thought that the largest initial market for jets designed in the United States would be for long-range planes, and that soon after long-range jet services were introduced, services on the shorter segments would be upgraded by long-range piston aircraft displaced by the jets, thus limiting the market for Jetliner-type aircraft. On the other hand, Convair realized the manufacture of Jetliners would offer the exceptional long-term advantage of entering the jet transport market early. The Convair exercise required several months for completion, during which intermittent discussions continued between AVRO and Hughes.

Howard's plan to manufacture Jetliners dragged on a while but finally did not work out—not because of Convair's lack of enthusiasm, but because U.S. military authorities were unwilling to permit use of Convair's factory space for commercial projects. I suspected that in addition to the usual factors, the military's position reflected high-level political considerations involving relations with Canada. Both the United States and Canada were manufacturing equipment for the Korean conflict. Thus, while Howard's plan to produce Jetliners in the United States did not succeed, he did manage later on to sell the Hughes Aircraft fire-control systems for AVRO's fighter program.

The Jetliner was used in AVRO's CF-100 development program for three years following Howard's flights. Finally, after its last flight, on November 23, 1956, Jim Floyd was placed in charge of ignominiously breaking it into small pieces, ending forever what had initially been an extremely promising future for the plane.[2] This had to be a heart-wrenching experience for Jim.

Project Mexico City

By the early 1950s, large jet engines had been designed that appeared to overcome most of the power plant deficiencies that had deterred the development of U.S. jet transports. P & W had the two-spool, wasp-waisted J-57's in early production and J-75's in early development, and Rolls-Royce had the bypass Conway in the works. However, all production was committed for military programs, with little indication of imminent release for commercial use.

My strong personal preference remained for jet rather than turboprop transports because of the greater speed, relative simplicity, and lack of vibration of this type plane, and my confidence that fuel efficiency would be improved. Howard was more amenable to turboprops than I, but he had agreed that the goal of deploying one rather than two basic fleets to serve TWA's domestic and international routes was desirable to provide attractive through-plane schedules and attain good operational efficiency. This called for the development of turbine transports capable of providing reliable year-round nonstop transatlantic operations.

Boeing and Douglas had kept me fully advised concerning the 367-80 prototype and DC-8 programs. Both manufacturers were convinced that the P & W J-57's (later designated JT-3's), which they proposed to use when cleared by the military, would provide over-ocean range. They seemed content with the idea that the jets would frequently require landing for fuel in Gander, Newfoundland, or Shannon, Ireland, which the majority of piston aircraft had been doing for years. My current negotiations with Lockheed over the Constellation 1049E were intended to produce true nonstop transatlantic planes. I was convinced that nonstop piston services would become commonplace, as in fact they soon were. Because the time lost for refueling jets en route would seriously undercut the flight time saved by the jets compared to the anticipated long-range pistons, I believed nonstop capability of the jets to be essential.

Detailed analysis by my staff confirmed that transatlantic nonstop services could not be achieved with acceptable schedule reliability with any of the proposed four-engine J-57-powered airplanes. Higher thrust engines were required. (Shortly after the Boeing and Douglas jets were introduced in 1958 and 1959, respectively, P & W developed a bypass version of the J-57, which produced adequate thrust; however, while bypass thermody-

namic cycles were well understood in 1953, design conversion was yet to come.)

The more powerful P & W J-75's (later, designated the "JT-4's") were also being developed for military projects but were not yet in production. The J-75's gave promise of enabling nonstop transatlantic operations, but only after operational experience had been accumulated. Because they were not slated for early production, it seemed that the proving period would require considerable time. P & W representatives judged that J-75's could not reasonably be offered for civil transport applications until several years after the J-57's, if at all. If this point of view were taken at face value, it appeared that early transatlantic nonstop jet services could only be realized by six-engine, J-57-powered; or four-engine, turboprop transports, which though slower burned less fuel. I thought the mechanical complexity, 100-mph nominal speed disadvantage and greater vibration of the turboprops would quite obviously make them less attractive than jets, and the use of six rather than four jet engines was questionable. I also believed that the discouraging comments of P & W's representatives were in part the result of their natural reluctance to push a new engine when the older one was doing so well and might conceivably be satisfactory. Once the need for more powerful engines was generally recognized, I was sure that P & W would not allow the market to go begging.

In mid-1954, Project Mexico City appeared to offer an alternative solution to the range problem. AVRO Canada's Jim Floyd suggested the development of transport versions of A. V. Roe's (the parent company) Vulcan delta-wing jet bomber. He wrote a confidential follow-up letter, October 27, to summarize pertinent discussions between Hughes and Crawford Gordon and present two design concepts: the Atlantic I for coast to coast, and the Atlantic II for transatlantic services.

The Atlantic I was essentially a new design except for use of the Vulcan outer wing and some landing gear and control system components. The proposed wing was 22 feet greater in span than the Vulcan, and had a new wide-span center section. The fuselage was elongated and increased in diameter to accommodate 120 passengers. The Atlantic II was smaller overall, configured to accommodate only 100 passengers. Both models were to be powered by four Rolls-Royce Conway engines buried in the wing roots and were expected to cruise at high subsonic speeds.

Both concepts were intriguing, but they contained some preliminary design proposals I thought unsuited for airline operations: thrust augmentation for takeoff by rockets or engine afterburners, two 16-foot-diameter parachutes for slowing the plane after landing, engines buried in the structure, and delta wings. I thought airport noise ruled out rockets and afterburning; drag parachutes appeared to be an abomination for airline use; buried engines raised serious questions of fire and maintenance accessibility; and precious little operational experience had been accumulated with delta wings compared to decades of tough pioneering with conventional aircraft, during which bitter experience generated many improvements. The fact that it was necessary to propose such unorthodox features to achieve acceptable performance demonstrated the marginal nature of jet transport design in 1954.

During early 1955, after I discussed my concerns, Jim proposed a new six-engine conventional design that eliminated most of my objections and which appeared to have excellent international range capability. I discussed it with Howard. He took immediate interest, insisted on absolute secrecy, and tabbed the project "Mexico City."

Jim claimed the plane, equipped with a distinctive, double-deck fuselage, would routinely be able to fly 138 passengers against winter head winds from Rome to New York at high subsonic speeds—a demanding design objective indeed for mid-1955, when the Boeing and Douglas jets could not be shown to fly nonstop New York-London with good schedule reliability. The AVRO was to be powered by six P & W J-75 engines, the most powerful in the offing. Single-deck and mid-wing variations were also proposed.

To save development time and cost, Hughes suggested that consideration be given to the use of Boeing B-52 wings, engine nacelles (eight J-57 engines), and empennages with fuselages to be designed by AVRO. Floyd examined this idea. The resulting preliminary design incorporated a conventional tricycle-type landing gear rather than the B-52 bicycle type, four double nacelles slung below the wing as in the B-52, and long, torpedo-shaped external auxiliary fuel tanks extending ahead of and behind the wing between the inboard nacelles and the fuselage. While use of the B-52 components would have saved time and money, conversion engineering would still have been formidable. Except for the care and feeding of eight rather than six engines, the design looked fairly attractive.

I was not at all surprised when William M. Allen, Boeing's chief executive officer, indicated he had no interest whatsoever in undertaking special arrangements with the Air Force for permission to use the B-52

components or in helping AVRO become a competitor in the large transport market, particularly because PAA, AAL, and other airlines had already expressed serious interest in Boeing 707's. (PAA and AAL ordered 707's a little later, during October and November 1955, respectively.) Allen closed the subject by flatly refusing to seriously entertain Howard's joint venture suggestion, which did not enhance Howard's feeling toward Boeing.

Mexico City, however, was not terminated. Jim Floyd continued to offer long-range jet proposals in profusion. He forwarded technical data from time to time, which was discussed by phone or during personal meetings, some involving Hughes. We had considered no less than 14 different designs—Schemes A through N—by April 1956. All were intended to leapfrog the Douglas and Boeing jets by providing substantially greater payload-range capability: not only a desirable operational feature for TWA, but also an important sales consideration for AVRO because initial production would lag appreciably behind the other manufacturers.

In the spring of 1956, two or three months after Toolco's initial jet orders were placed, Jim Floyd, several AVRO executives, and I met with Howard at the Beverly Hills Hotel to review the latest AVRO design. While walking to the car after the meeting, one of the executives told me that AVRO had placed that morning with Hughes Aircraft a major order for advanced armament fire-control systems for its fighter program. That very evening Howard called me at the Bel Air Hotel and asked that I drop the Mexico City project. He said, "Bob, don't do it precipitously. Don't you see? Let it die over a period of months."

Was the AVRO affair only a charade to land a lucrative contract for Hughes Aircraft? It might have been, but I believe there was much more to it than that. After the Boeing JT-4-powered long-range jets were offered during the fall of 1955, and Howard finally faced up to the fact that they would be good planes, available much sooner than the AVROs, he may have decided against the AVRO program but elected not to make this known until after the fire-control contract matter had been settled, lest he upset the negotiation and dissuade AVRO from committing. The enormity of the financial undertaking that would have been involved by ordering both Boeings and AVROs also may have been a deterrent, although this consideration did not stop him from subsequently making further major fleet buy commitments. His initial interest in the AVRO transports was probably sincere, at least to the extent of exploring a potential opportunity;

had delivery timing been favorable, he might have elected that course. I never doubted that Jim Floyd and his team could have produced excellent jet transports well tailored to satisfy TWA's operational requirements, notwithstanding the shadow of possible government interference cast by Minister C. D. Howe's untoward actions in the Jetliner affair. The design of AVRO's Jetliner was superb, and given the freedom to perform, comparable results seemed likely.

During 1958–59, Jim Floyd proposed several supersonic transports for TWA's transatlantic operations—as far as I know, the first supersonic proposal by a responsible, major manufacturer. The first was designed to operate at 900-mph supersonic speeds; the final one was an attractive, extremely sleek, 1,200-mph jet with a double-ogee wing plan-form. It would have been years ahead of anything else. Nevertheless, by late 1959, Howard's jet programs were in such an acute state of disarray that serious procurement consideration was utterly inappropriate—indeed, impossible.

The inviting AVRO designs, like so many early attempts that produced paper rather than real airplanes, played a significant role in advancing the art of jet transport design. Such efforts highlighted the need for research and development programs targeted toward solving important operational needs, for example, more efficient, higher-thrust engines; more effective flap systems for swept-back wings to reduce takeoff and landing distances; reverse thrust for landing safety; the development of external noise attenuation devices; and improved interior sound proofing. I, with some other airline representatives, helped define research programs through membership on NACA advisory committees, as well as through negotiations and by taking advantage of every opportunity to press for constructive action by the manufacturers.

Notes

1. The manufacture of transports by Hughes was prohibited by the Federal Aviation Act and the CAB orders permitting his original acquisition of interest in TWA. Implausible as it may seem, Howard's plan was to somehow obtain immunity from the CAB to manufacture aircraft for TWA and, after manufacture was well under way, obtain expanded authority to sell planes to other airlines.
2. Jim has chronicled A. V. Roe Canada's turbulent history, including the successes, tribulations, and disappointments encountered in the Jetliner development program, in *The AVRO Canada C102 Jetliner* (Boston Mills Press, 1986). I commend this book to those who wish to know more about this technically

advanced company, which produced superb, world-beating civil and military aircraft, but which nonetheless was destined for dissolution. One can only wonder what success the pioneering Jetliner project might have enjoyed if AVRO had been permitted to develop and market the planes in a timely manner, as it wanted. While a great disappointment for Jim Floyd and his associates, the Jetliner demonstrated close at home the great promise of jet transportation and thus helped pave the way for the spectacular jet age.

18.
The Convair Digression

Having concluded at the end of 1952 that British turbine designs should be passed over in favor of prospective U.S. aircraft, it became immediately incumbent on us to try to determine the manufacturer or manufacturers most likely to produce those better planes and to work with them in developing the best possible planes for TWA's use. Busy as we were with Constellation and other piston-aircraft problems, I eagerly found time for this.

I have already described the abortive YB-60 investigation with Convair and the far more serious consideration given the AVRO Jetliner and subsequent AVRO proposals. Indeed, Project Mexico City was actively discussed through 1955 and not dropped until 1956. The major programs, however, seemed certain to be at Boeing and Douglas. In 1953 another would-be player entered the arena, shrouded in a secrecy extreme even for Hughes.

The Romaine Street boys left word during early July with Ralph Ellinger at his Lockheed office that Howard wanted me to meet him at the Beverly Hills Hotel. I excused myself from one of my fairly frequent Lockheed 1049E meetings and drove to the hotel in one of Howard's Chevrolets.