The Paper Pyramid

By GROUP CAPTAIN H. R. FOOTTIT

"If we do not change our ways we will, I believe, destroy the very foundations of our strength — which are our inventive genius, imaginative thinking, technical skill and know-how."

—*Air Marshal Sir Basil Embry*

SAMUEL PEPYS was quite a man. As every school boy knows. Peppys caroused through the crooked streets of London late in the 17th century. And he left us an immortal record of his amorous adventures in the famed Pepys' Diary. But Pepys was much more than a mere man-about-town. Long before he laid down his pen, he took up the job of Secretary to the British Admiralty. From this position, as it spread in scope with the growth of the Royal Navy, he laid down the regulations that ultimately formed the administrative foundation for both the Navy and the Civil Service. For Pepys loved law and order. Yet he was quick to see, during his trip to Spain in 1684, that the great and dying Spanish Empire had regularized almost everything. There was a pyramid of rules and paper work that stretched from the king's court to the humblest peasant.

Here formality was everything, and action nothing. As historian Arthur Bryant said in his book *Samuel Pepys Saviour of the Navy,* "It was part of the inevitable process of decay through which all empires pass.' While Pepys put it far more bluntly: "In a word, never were a people so overrun with fools in all states as they are."

More Paper: In aviation in Canada, today, we are busily building our own paper pyramid. In the aircraft industry, in the air transport services, in military aviation, and in the government's aeronautical agencies, there is a gradual groping towards maturity. And this involves more and more paper work, more and more minutes of meetings, and more and more control by committee. We are surrounded by Department of Transport Circulars, Engineering Change Proposals, Minutes of the Capital Expenditures Committee, and a myriad of forms and rules and letters, and reports, and memoranda.

Although, in our aeronautical youthfulness, I'm sure we're on the right track, still the storm warnings are on the horizon. For each paper pyramid is often a pathway for decision. And every extra paper that is added to the path takes extra time. Thus, as the path lengthens, important decisions get delayed. And the higher we build our paper pyramid, the greater the delay and the less chance we have of keeping up with the rapidly moving state of the aeronautical art.

We would be naive in the extreme, of course, if we said that we could do without all paper work. From flying fighters to selling airline tickets, aviation today is a complex business. Some paper authority is therefore necessary if we wish to control an operation and ensure its progress. Yet Diderot, that great thinker of the era before the French Revolution, once said: "Be wary of him who seeks to establish order; to order is to obtain mastery of others by giving them trouble." There are many Canadians in many avenues of aviation who sympathize with Diderot's viewpoint. And they don't have to look far for an example of a pile of paper that delayed a decision and snuffed out the fire of progress.

Bogged Down: When the thunder of Hitler's divisions was resounding through Europe, and the German

Luftwaffe was pounding the British from the night skies, aeronautical engineer and novelist Neville Shute joined the Technical Department of the Admiralty. Here he found the whole production system bogged down in a vast and complicated paper routine. Says Shute in his book *Slide Rule*, "As civilians in uniform we found the Admiralty system to be better adapted to conserving money in peace time than to getting production in time of war."

Fortunately he soon developed a system of telephone calls with different departments so he could get the necessary decisions and let the appropriate papers follows some few weeks later. But it wasn't easy. This meant that many high ranking naval officers had to say "Yes" or "No" to production schemes costing thousands of English pounds on the basis of a few minutes' call. "These naval officers," says Neville Shute, "were as brave as lions, and would have risked their lives in a destroyer torpedo attack without a second thought. But to be asked to risk their jobs on a verbal decision involving public money often seemed to them unfair."

In the United States we find similar examples of routine paper systems that are trip-wires of progress. There is no doubt that the U.S. Air Force has been the greatest proponent of supply by air. From World War II, through the dire days of the Berlin Air Lift and the Korean Air Lift, the USAF has argued that it is vital, cheaper and quicker to air freight critical cargoes than have them rot at a rail head or a dockside. But General E. W. Rawlings noted a while ago, "It is not unusual for about 80 percent of our present support cycle — the time which elapses between requisition of supplies by an operating unit and receipt of those supplies — to be consumed not in transport but in transmitting and processing paper work and processing the material itself." The USAF has been trying desperately to improve a situation which General Rawlings tagged as "the great drag chute of paper work and processing."

Get It In Writing: While a pyramid of paper may delay things, on the other side of the coin, it can also offer definite advantages. Thus we find such top rate administrators as Sir Winston Churchill strongly supporting the written word. He made himself clear to his staff, as he explains in his book *Their Finest Hour*, "Let it be clearly understood that all directions emanating from me are made in writing, or should be immediately confirmed in writing, and that I do not accept any responsibility for matters relating to national defence on which I am alleged to have given decisions, unless they are recorded in writing."

I was talking over administrative systems, from the high level Churchillian memoranda to the simple air lift forms, with Philip E. Halsey of de Havilland Aircraft of Canada recently. He told me about the system that British Overseas Airways used when they started operations with the Comet I jet airliner in 1952. The Comet wasn't exactly new at that time. It took off on its first test flight in July, 1949, just beating Avro Canada's "Jetliner" for the honors of being the first jet-engined airliner to fly. With two years flight testing behind it, the Comet went into regular passenger service with BOAC. The Airline already had a flight log system that the crew filled out as the transport wended its way over the route. But

The paper pyramid paid off during the introduction into BOAC service of the de Havilland Comet I. The mass of reports, investigation and procedures that were put down on paper by both manufacturer and operator, materially speeded the Comet's introduction.

when the Comets got started they found it necessary to get far more information from their air and ground crews.

At the time of BOAC's first Comet service, Phil Halsey was with the parent de Havilland Company in England, and intimately connected with these difficult days. He therefore had access to the multitude of forms and reports on instrument readings, maintenance troubles, flight delays, and engineering information that kept the Comet's "flight engineer so busy he had to work his fingers to the bone." On top of all this there was the standard Complaint & Defect Form that the aircraft's Captain handed in. All these were collected with similar forms put in during regular inspections, and the whole system fed into the de Havilland Service Department for analysis and action.

Paying Off: The paper pyramid, of special forms — signed, countersigned, and with approval signatures as it progressed up and down the administrative machine — were all part of the Comet I's birth. However, as Halsey said, "With all this information as ammunition, and the results of many special investigations that were reported on, the contractor and operator held monthly or bi-monthly meetings to ensure that a constant check was kept on the operation of the aircraft, and that the appropriate action was taken as rapidly as possible." The paper pyramid paid off. With this as a link between the airline and the builder, the Comet I went quickly into service and compared favourably with BOAC's piston engined transports. The Comet's daily utilization was somewhat lower, but with its higher block speed it finally covered more passenger miles than any other airliner in the fleet.

However, disaster struck. On January 10, 1954, the prototype Comet had just taken off from Rome's Ciampino Airport and was climbing for altitude. The captain was talking over the radio to another BOAC captain of a nearby Argonaut about the tops of the cloud cover. He started a sentence: "Did you get my . . ." But he never finished it. The Comet's pressurized fuselage ripped asunder. Three months later a similar crash occurred near Naples, Italy. And the Comets were grounded until the Royal Aircraft Establishment finally pieced together the cause of the failure in a master stroke of aeronautical detective work. But for this unfortunate event, the Comet would no doubt be piling up an impressive record of service today — and largely through a paper recording system that was a bridge to quick corrective action.

MORE CF-100's OVERSEAS

The RCAF's second CF-100 squadron to leave Canada for NATO duty with No. 1 Air Division in Europe, will fly overseas in February of next year. The squadron chosen to follow 445 overseas is No. 423, currently based at St. Hubert, P.Q.

No. 423 will be based in Europe at Grostenquin, France, where it will replace 416, a Sabre squadron. No. 416 is to be disbanded and will reform later as a CF-100 unit, based at St. Hubert. The first CF-100 squadron to go overseas, 445, is now based at Marville, France. Two others will go over later and will be based respectively at Zweibrucken and Baden-Soelingen, both in Germany.

The airlines are not the only ones that have built paper administrative systems with success. I talked to E. H. Higgins, Chief Project Engineer for Canadair Ltd., and one of Canada's leading aeronautical engineers, as well as being, I believe, an expert on engineering organization. As Ed Higgins pointed out, a "one man" organization, where all decisions and papers are funneled through this key man, is undoubtedly the most efficient way of doing things. It reduces the volume of paper in the pyramid. But there are limitations to what one man can handle. Higgins believes that the engineering staff in such an organization must be small — not more than 200 people — and all of these must be engaged on one project. Moreover, the head man must have outstanding technical and administrative abilities.

delegation of authority

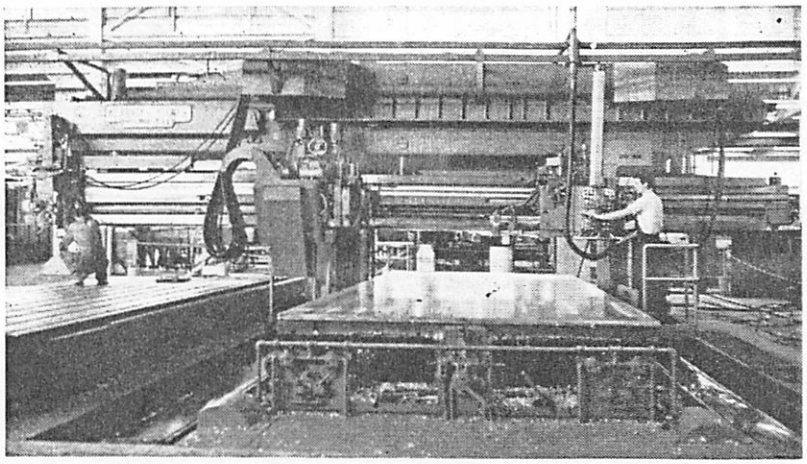
"IN RECENT years," Ed Higgins says, "the engineering task of a single airplane project has expanded so tremendously that the one-man system is no longer adequate. Now decision authority must be delegated to several people. The effect of growth, beyond the capacity of the one-man organization, is the need for more complicated paper aid such as Schedules, Progress Reports, Minutes of Meetings, and Formal Technical Reports."

It is readily apparent, then, that the size and complexity of a modern airplane are key factors in adding to the size of any paper pyramid. Moreover, the increased numbers of engineers adds a further burden. Says Higgins, "In the one-man set up, the head man knows just about everything that is going on so that he can also act as an expeditor. But in a large organization, with distributed authority, another group of people must be created and assigned the task of searching out the sources of delay. You can never count on each man always doing what he is expected to do and doing it on time, so that a system of cross-checks must be provided."

All this, of course, merely aggravates the paper work problem since the new staff for cross-checking the working staff, also originate a number of papers. One way of cutting down on this is to have committees on the various subjects that need co-ordination. The RCAF has developed a system of co-ordinating and Steering Committees for all major development projects. A similar system is used by Canadair on the RCAF's maritime reconnaissance version of the Britannia. There is, for example, a Canadair Joint Co-ordinating Committee. This is a group from both the engineering department and the manufacturing department. They meet on call and exchange information of such general interest as data on a new drawing number system, non-standard material sizes, decimal dimensions, and material stock sizes.

Limitations: Committees, however, have limitations: they must turn out minutes of their activities and they must assign work to designated members and then ensure that the work is carried out.

Whether decision, co-ordination, and follow-up are left with a committee or as a routine staff job they all added to the paper work. But neither the airlines nor the aircraft companies have run into such criticism of their paper systems and committee structures as have the government organizations. Wesley V. Hurley, former USAF Deputy for Research & Development Programs and presently on the management staff of Avro Canada, summed it up last May at a banquet of the Photographic Engineers: "It is somewhat discouraging," he said,



Avro's New Skin Mill

A 200-ton skin milling machine, biggest of a battery of new machines lined up for the production program of the supersonic CF-105, has gone into operation at Avro Aircraft Limited, Malton, Ont.

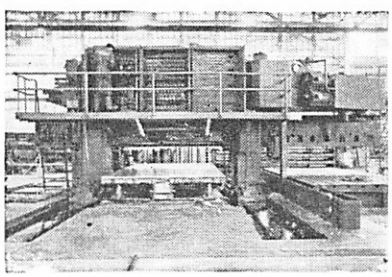
The only one of its type in Canada, and by far the most versatile in its field, the new mill is capable of carrying out skin milling work on all aircraft designs of the forseeable future.

With the advent of the supersonic era, the skin mill — which carves complete sections of aircraft wing skins and their stringers out of solid metal — has become increasingly important. First, because there are considerably fewer rivets required in the finished wings by using this method, it is much stronger and the wing surface much smoother. Second, under the tremendous stresses of ever higher speeds, fewer rivets and rivet holes decreases the possibility of fuel leaks in the areas of the wing tanks.

Alongside the 28 ft. x 9 ft. work table (centre of upper picture) of the Avro mill is another table on which the template (left of upper picture) is placed. A stylus is guided by the operator along the contours of the template. This stylus, under eight ounces of pressure, transmits its readings to an electronic centre (see platform above work table in bottom picture) which sends out the pattern to the large travelling head of the machine.

As the 70-ton head and gantry starts to move, the tool attached to it begins to trace the same pattern in a solid slab of aluminum, ripping the chips out at high speed. For example, during recent test runs a tool taking a cut 2¾" wide by 1¾" deep chewed through the metal at about 9 ft. a minute.

To keep the temperature down while running at these speeds, a flood coolant system pumps 75 gallons of coolant per minute. On a typical skin job, the machine will



start with a 3,300 pound billet of aluminum and end up with the finished product weighing less than 300 pounds . . . the machine having milled out over 90% of the weight in chips.

To keep the machine from burying itself, the chips are deposited on a conveyor belt, which in turn feeds them into mobile scrap bins. The volume of chips cut during one working day would fill four average-size garages.

The large slabs of aluminum are held in position on the work table by vacuum. The tool can be tilted and swivelled to facilitate the cutting of tapered skins and converging ribs.

The mill is also equipped with safety devices. If the vacuum holding the work drops below a certain minimum, the tool stops cutting and retracts. The same thing happens if the tool begins to overheat. To prevent a tool from cutting too deep and slicing into the harder metal of the work table, a two-inch slab of aluminum is permanently fitted over the whole table area.

The machine was built by Kearney & Trecker of Milwaukee to Avro specifications and cost over $1,000,000 to design and construct, though the price to Avro was only $325,000 because the Canadian firm was pioneering in this field. Kearney & Trecker expects to recover the development costs on future sales which will be approximately $600,000 per mill.

"to find that it is we who are leading the way in developing the collective approach to technology." He goes on to point out that we of the Western World are building up our collective approach by "the development of tortuously systematic management procedures for control of resources with which the individual must work," and "the making and review of managerial decisions by countless boards, committees, and *ad hoc* working groups."

The usual yardstick for comparing our system is, of course, the dictatorship of Russia. Here, for some reason which we find baffling, the Russians seem to be able to develop airplanes quicker than we can. Part of this speed is laid to the fact that they have shortened their administrative routines. I don't believe we know all the details of this Russian procedure. But I understand that a measure of co-ordination goes on by rotation of the key personnel between the training academies, the research institutes, the government aircraft ministries, and the major aircraft plants. Thus, they knit the whole upper echelon into a co-operative group. Each top man knows what the other is doing, and the general nature of the work since each has also done a similar job. This "multiple hat" system keeps the ruling group to a small circle who can get together and so cut out some of the paper work.

How well the Russian system really works, of course, we don't know. And the difficulties of determining how much paper work is really necessary are legion. The basic trouble is that we never know when we reach a mean. As Aristotle pointed out hundreds of years ago, "Matters concerned with conduct . . . have no fixity. The agents themselves must consider what is appropriate to the occasion." But one thing is certain. With a steadily rising tide of unrest with our paper pyramids in aviation in Canada we must be approaching a limit. Air Marshal Sir Basil Embry, in a recent radio talk, expressed the opinion that the U.K. has already passed the upper limit, and excessive paper work is cutting away the foundation of their technical genius. "We cannot afford," he says, "to consider everything and decide nothing," which is a product of a top-heavy paper pyramid. We should note his words. For the handwriting is already on the Canadian wall.