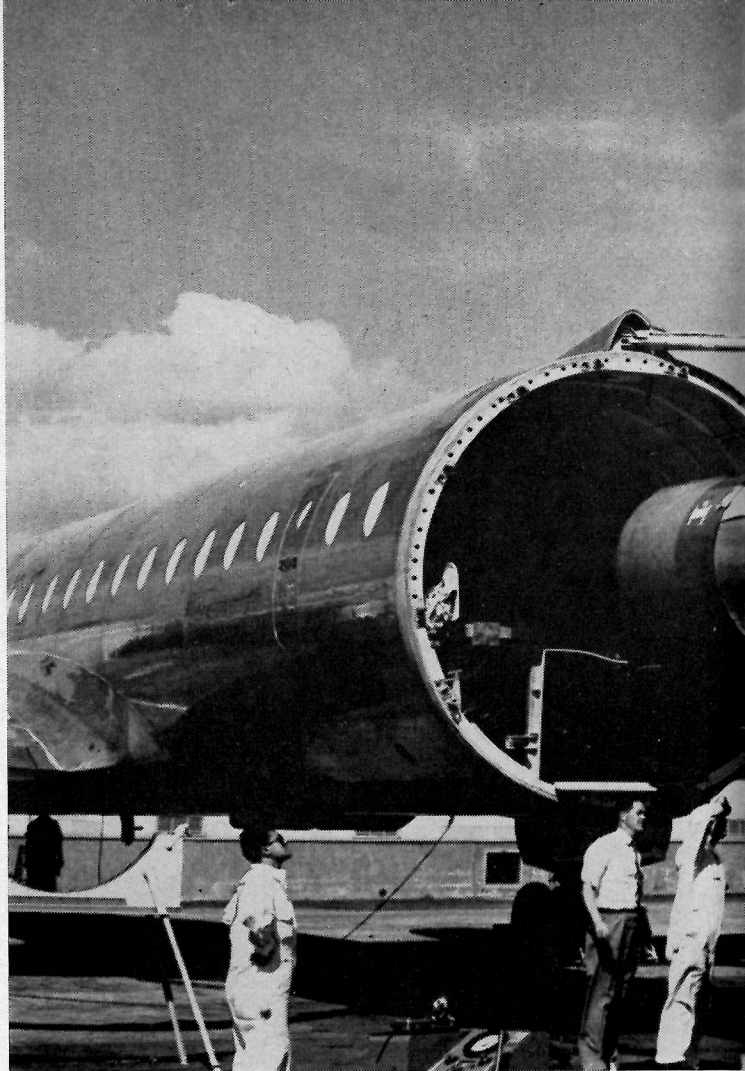


Canada's aviation industry finds itself in better shape than had been expected. CF-104 production moves into high gear, de Havilland continues its success in the STOL market and CL-41 looks a strong bid for export sales. But for the long term future all are agreed:



## Research and Development Is

By Ernie Hemphill

"The health of the industry tomorrow will depend on development work done today."

It would be difficult to state more accurately and precisely the challenge facing the Canadian aviation industry today than in the above words of Thor E. Stephenson, President of Canadian Pratt & Whitney Aircraft Co., Ltd. and recently retired as Vice-President, Industrial, of the Air Industries and Transport Association of Canada.

Competing in a market which places the ultimate premium on advanced products and techniques, Canada's industry must literally develop or die as a vital entity in the world aviation community.

Mr. Stephenson's observation, contained in his report to the AITA 27th annual meeting at Quebec City, was hardly in the nature of a revelation. But it takes on special significance in light of the climate in which the Canadian industry has struggled to subsist over the past three years.

Under former policy, which broadly speaking provided the Canadian aviation industry with an opportunity to undertake production of major weapons systems designed to meet the special requirements of Canadian forces, the very nature of the programs required support of vigorous research and development activity by both government and industry.

It was an era of outstanding achievement for Canada's aviation industry. A number of products and systems initiated during this period

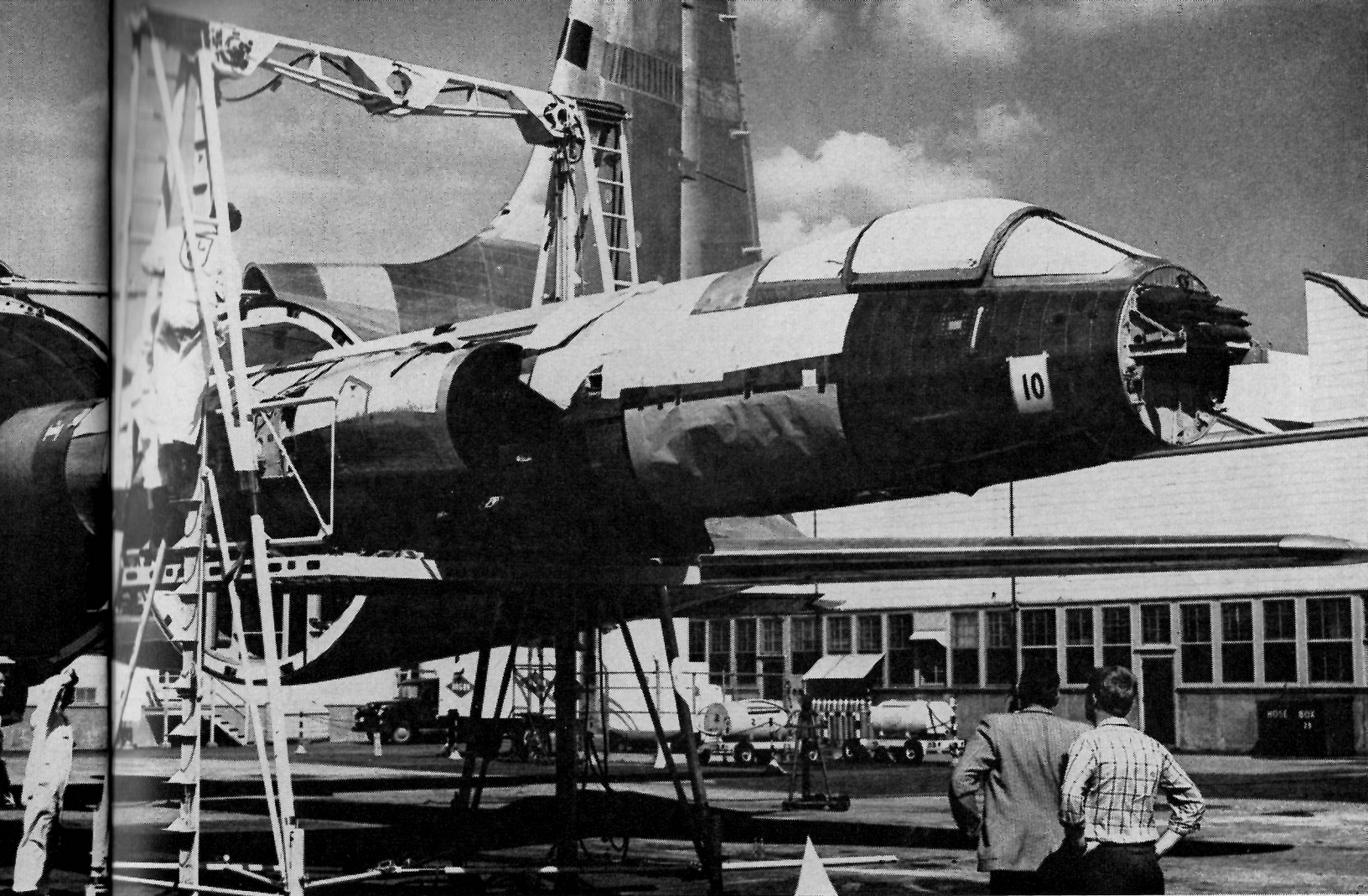
are still tops in their field with refinements and adaptations continuing to penetrate new markets.

In some respects it might be said that it was the high level of research and development activity, to be written off as it began to appear against the relatively few complete weapons systems which would be required to fill an exclusive Canadian use, which doomed this policy.

### Cost Beyond Means

Government decision was that the cost of such programs was beyond the nation's means.

Before moving to the open market for its defence hardware, the government initiated an arrangement with the United States under which the Canadian industry would be given an equal opportunity to com-



**WE DELIVER.** Demonstration at Canadair Ltd. shows how CF-104 Super Starfighters can be airlifted from factory to operational user aboard Forty Four swing tail freighters. Transport takes two CF-104s. Both aircraft are in production at Montreal plant.

## The Key to Market Success

pete for the production of equipment which in a broad sense had application to mutual defence efforts—the defence production sharing agreement.

With the framework for production sharing established the government formally announced cancellation of the then major unilateral Canadian project, the Avro Arrow weapons system.

The results are history, too well known by those who lived it to bear repeating here.

Of prime import to the matter of moment was the sharp drop in support of development activity by industry.

From a peak of \$53,424,000 on an equipment procurement expenditure of \$412,354,000 in 1957-58; it sank to a low of \$11,488,000 on equipment procurement to a value of

\$292,481,000 in 1959-60. It rose just slightly to \$12,631,000 on a \$287,303,000 procurement expenditure in 1960-61, and estimates for the current year call for \$14,200,000 in development money on about the same level of procurement expenditure as in the previous year.

### Support Essential

It was evident early in the production sharing program that the lack of government support for development activity was a serious handicap to the Canadian industry in its efforts to crack the overall North American defence market.

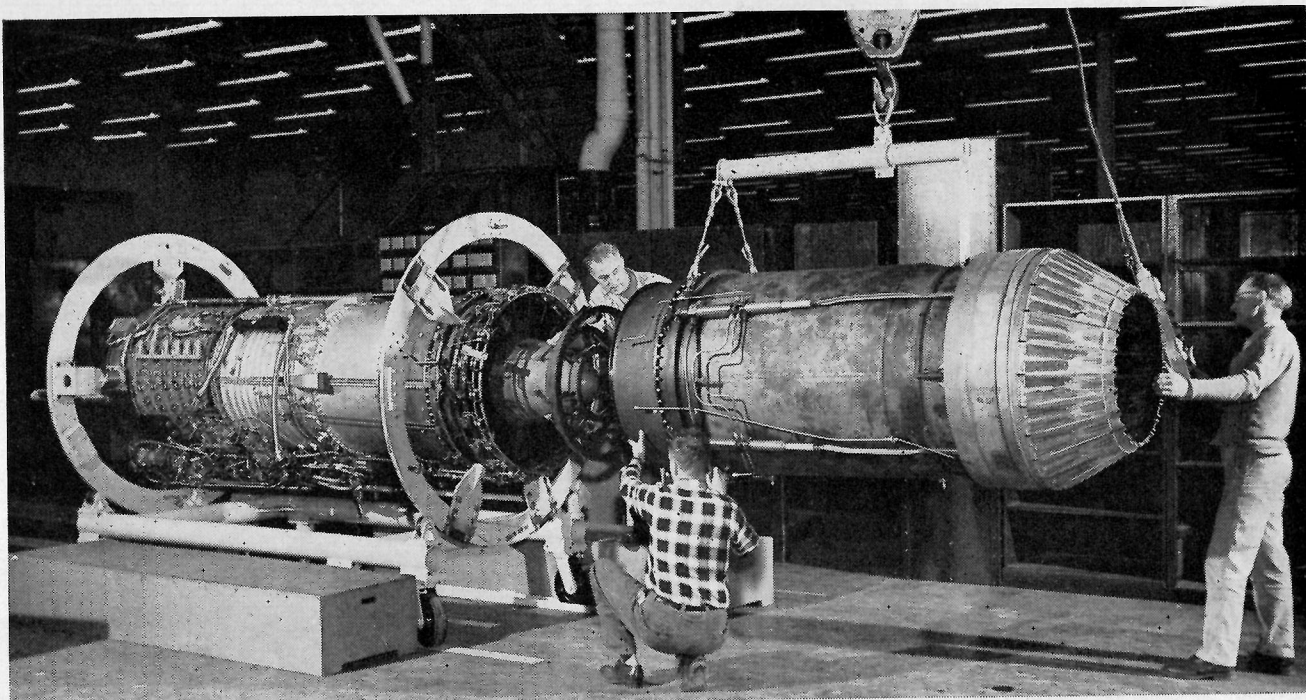
Vigorous promotion by the Department of Defence Production, determined selling and a high level of capability and contract performance by Canadian firms, plus an acceptance of the spirit of production

sharing by U. S. procurement sources led to reasonable success in the early stages of the program.

It became obvious after a short time, however, that the source best prepared to undertake production on a specific piece of equipment is the one which has done the development work. In the light of this, the Department of Defence Production expanded the sharing arrangement to include the development phase. There is already evidence that this move will provide some substantial production contracts as projects reach the usable hardware stage.

This was the background against which the industry heard details of a new government proposal to support the search for the advanced products which capture markets, the Defence Industrial Applied Research program. At the Quebec City meet-





**GE J-79 AT ORENDA.** Off the production line at Orenda's Malton plant have come power plants for Canadian Super Starfighters.

ing to provide a special AITA briefing on the program was John L. Orr, Director of Engineering Research at the Defence Research Board who was also recently named to head the Directorate of Industrial Research which will administer the new program.

The Quebec City session was Mr. Orr's second appearance before industry in his new capacity. Late in October he outlined plans for the program for members of the Canadian Industrial Preparedness Association during their annual meeting at RCAF Station Trenton.

### Strengthen Research

The DIAR program was established to promote and strengthen research capability of Canadian defence industry. This in recognition of the fact that in order to become self-sustaining, any continuing development activity requires a steady flow of new ideas and information from the research laboratories. Development needs the essential stimulus and back up of research—they must go together.

There are in Canada excellent basic and applied research laboratories, mostly in government establishments and to a lesser extent at the universities. In spite of this, it is felt, Canada has not been particularly successful in exploiting the results of basic research.

This latter is the task of industry. But due to many factors apart from the lack of financial support the gap between the research laboratory and

the production line has not been consistently bridged.

It is now the determination of the government to correct this situation in the critical defence sectors. By mobilizing the scientific and technical resources of industry it is hoped to contribute to mutual defence and increase Canada's ability to participate in the development and supply of defence weapons and equipment to meet North American and NATO requirements. The DIAR program will provide an essential complement to the existing development and production sharing programs of DDP.

So far there has been no indication as to the amount of funding which the government contemplates for the DIAR program. Director Orr however did provide CIPA and AITA members with a broad outline of what is proposed.

The program must be selective to avoid dissipating limited resources over too broad a front. Canadian defence industry must specialize in specific areas to achieve the degree of technological superiority by concentration of effort.

Initially, it is proposed to establish applied research programs in the fields of:

Electronics and physics; prime movers, energy conversion and propulsion systems; defence materials; aeronautics; transportation systems and mechanical engineering; weapon technology.

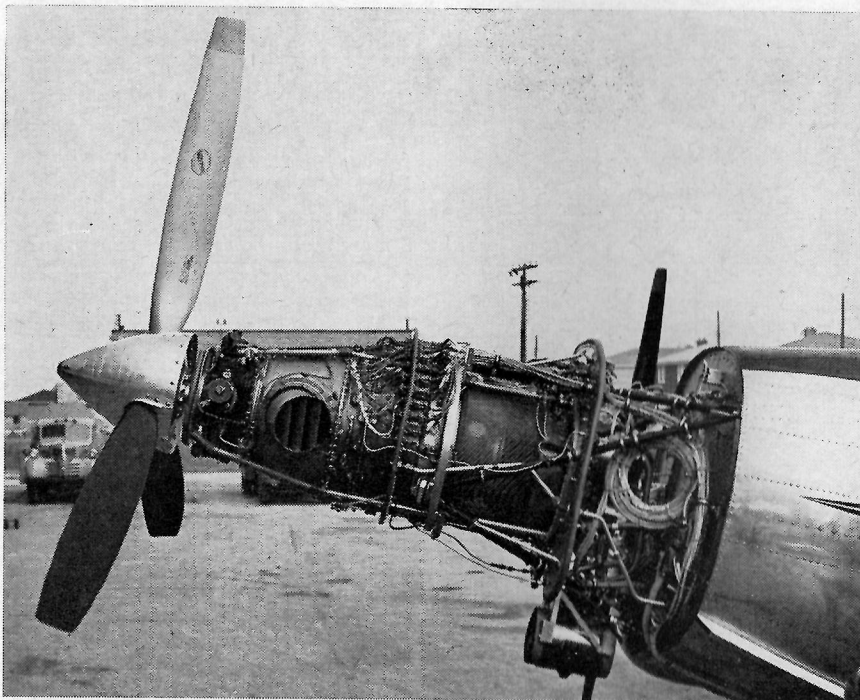
To facilitate translation of laboratory research into useful hardware it is proposed to introduce new ideas and scientific information into indus-

try at an early stage. The DIAR program will in this way provide an essential complement to DRB in-house research which will greatly enhance its value to national defence and collective security. The procedure is also seen expediting introduction of new technological advances into the design of military equipment, thereby shortening the development cycle.

Long term objective is to develop a self-sufficient research capability in Canadian defence industry which will enhance the technological resources



**DIRECTS RESEARCH PROGRAM.** Welcome detail on proposed government support for industry research was provided AITA members by John L. Orr, Director of Industrial Research, at DRB.



**RAPID PROGRESS.** Into the air in a Beech 18 flying test bed went Canadian Pratt & Whitney's promising PT 6 lightweight turboprop, a completely Canadian development.

of the country and also benefit the civil economy.

Functions to be performed by the Directorate of Industrial Research:

- Provide guidance on R&D opportunities for Canadian industry based on knowledge of future military requirements and technological possibilities arising from defence research activities.
- Ensure co-ordination of DIAR projects with DRB or other Canadian research programs and with related activities in allied countries.
- Supply to the contractor through the DRB Directorate of Scientific Information Services relevant scientific information based on current defence research and development activities in Canada and elsewhere.
- Through participation in Tripartite and NATO technical collaborative activities, to seek allocation of specific defence problems to Canada, providing opportunities for participation by Canadian industry in subsequent development and production phases.

#### **Ideas from Industry**

Though general guidance as to promising fields of endeavour can be given by DRB and the services, industry itself is expected to advance new ideas for research projects in support of which the government would be prepared to make a substantial financial contribution. This is looked upon as particularly important since in addition to making the most

effective use of the talents of industrial research teams, the success of the program will be strongly dependent on the interest and motivation of the firm in the project as well as in research activities generally.

Many factors must be taken into account in assessing specific project proposals, but one of the most important will be calibre of the scientific staff upon which the success of any research program critically depends.

On the technical side projects should be problem oriented or at least aimed at establishing a competence in a particular technological field of defence interest.

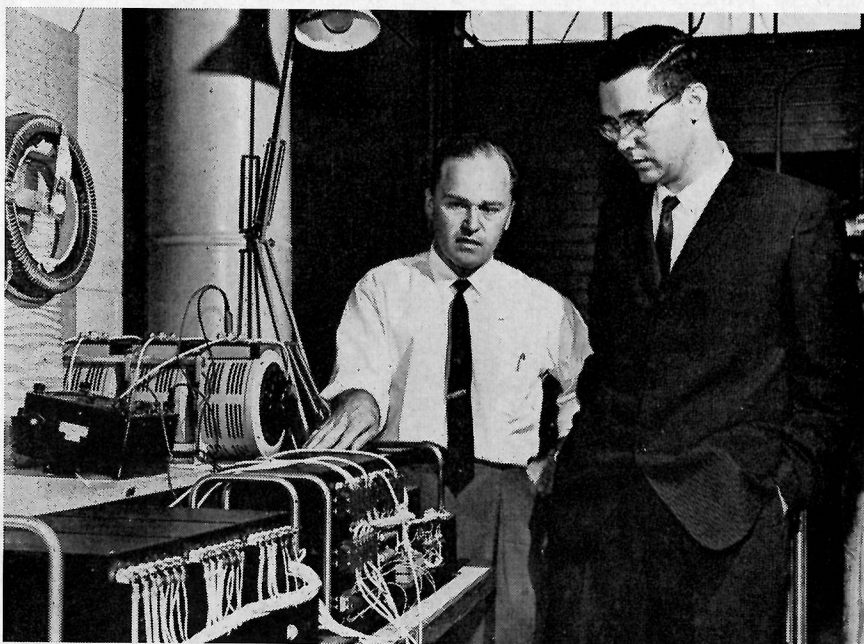
Preference is to be given to longer term projects offering good potential for achieving major advances in performance or technique, rather than projects offering only marginal improvements over the current state of the art. Emphasis will be placed on advancing the state of the art rather than routine product improvement. Hardware development must be excluded except insofar as required to demonstrate technical feasibility.

#### **DDP to do Contracting**

The Department of Defence Production will be responsible for contracting under the DIAR program. In the case of DIAR projects, there must be some recognition of mutual interest on the part of the contractor. The most tangible evidence of such interest would be to have a stake in the venture by sharing of costs. Therefore, the contractor will be expected to forego any profit in the research phase and although the general objective would be to achieve a matching contribution from the contractor, the exact proportion will depend on circumstances.

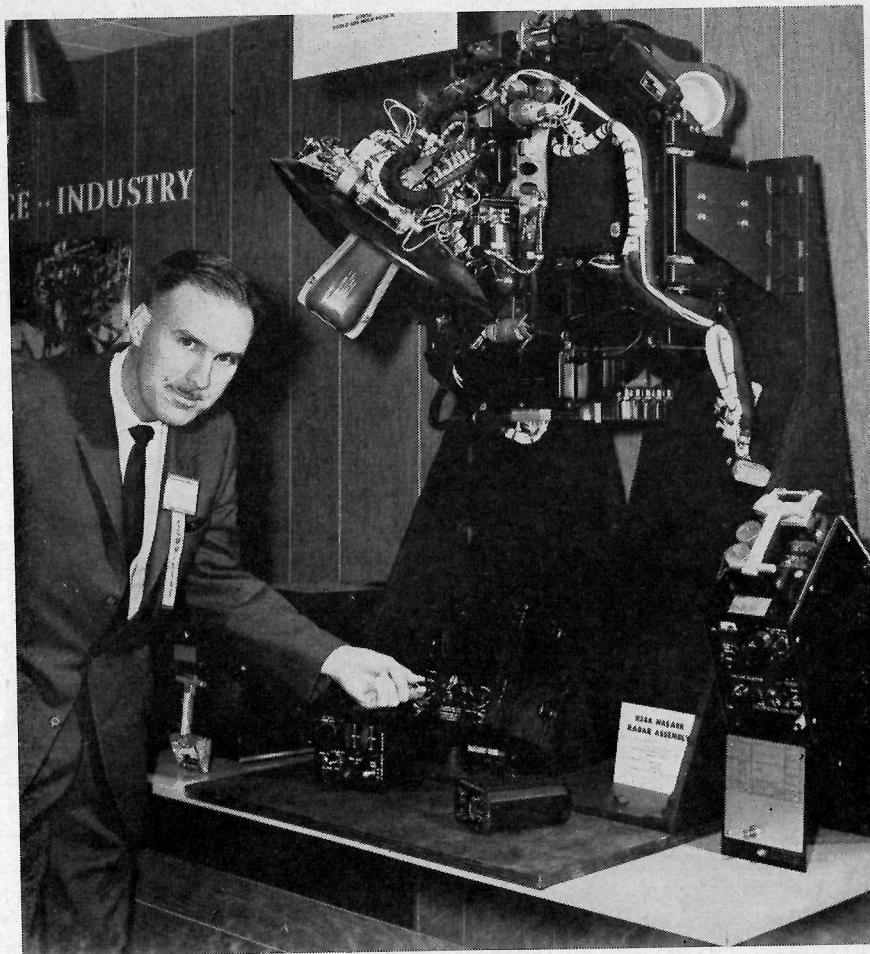
In return, the contractor would retain all proprietary rights except for royalty-free use of any inventions by the Canadian government and the right to disseminate technical information for defence purposes.

The contractor thus will be free to exploit the results of DIAR proj-



**PRODUCTION SHARING.** Magnetic amplifier and reactor units built by Garrett Manufacturing Ltd., of Toronto on order from Electronic and Ordnance Division of AVCO Corp., Cincinnati, are checked out before initial delivery of quantity to be used for control of radar equipment which is part of the North American Defence System.





**CF-104 SYSTEM.** Canadian Westinghouse is prime contractor on production of the NASARR general-purpose radar system for RCAF Canadair-built Super Starfighters.

ects for commercial purposes. It is pointed out the government already provides tax exemptions for R&D expenditures, a situation which should assist the contractor in sharing the cost of projects under the DIAR scheme.

DIAR Director Orr's briefing could not have been given before a more interested group. More support to industry research and development has been a matter of major concern to AITA members over the years and as pointed out earlier has been particularly acute since the change in policy which ended the Arrow program.

### Industry's Case

Retiring AITA President F. T. Wood, Administrative Assistant to the President of Trans-Canada Air Lines made industry's case in his report to members.

"The amount of research carried out by the Canadian government in its own laboratories is, proportionately, equal to that carried out by any western government. Research and development in industry has been, however, far from a competitive posture.

"There are many reasons for this, some of the important factors being:

- The government in its defence contracting does not in general recognize research and development costs as proper charge against production orders. Thus current business cannot be used to ensure future business, a most unhealthy situation.
- There are no current research and development programs of a major nature sponsored by the Canadian military services. This is a situation practically without parallel in the western world and one which cannot continue. The situation implies that the Canadian military forces have no requirements that can be met by aviation products developed in Canada, which is quite clearly not the situation."

The retiring AITA President went on to commend the Department of Defence Production for its efforts to fill the development void.

"Regrettably," he continued, "the funds available to this department are very small and amount to about two percent of the expenditures being made for procurement and support of standard military hardware. In the

U.S., 25 percent of the funds spent with the aerospace industry by the various government agencies is spent on research and development.

"A comparison of these statistics does not lead to any great confidence in the ability of Canadian industry to compete in future orders."

Mr. Wood had not the benefit of the briefing by DIAR Director Orr prior to giving his report and so was in a position to make only passing reference to the proposal.

"A worthwhile step being taken is the establishment of an applied research fund, to be administered by the Defence Research Board. This program is so new that its value or defects cannot now be assessed.

"There are warning signs on the horizon, however, that any project supported by this fund must have a clear end use. In many instances, if the work is to be truly of a research nature, the pot of gold at the end of the rainbow cannot be so clearly seen. This fund should have as its aim the advancement of scientific and technical knowledge, and projects meeting this requirement should be supported."

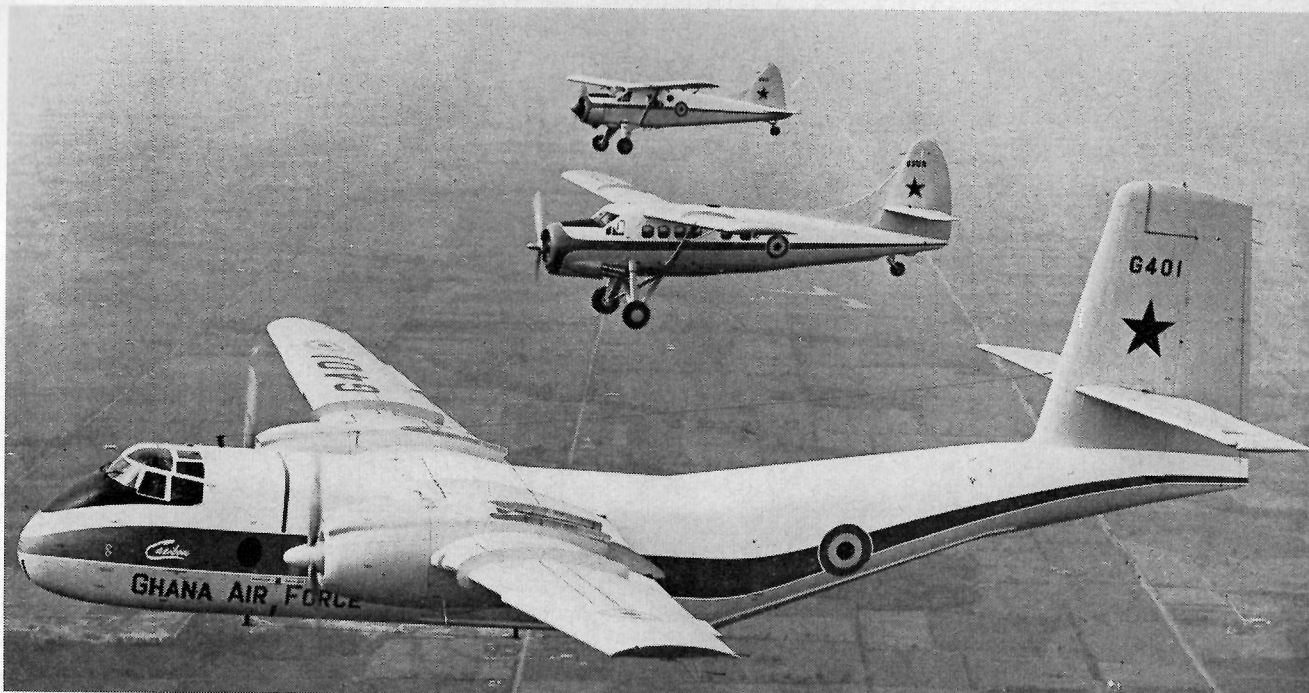
### Wait and See

Reaction following DIAR Director Orr's briefing was not too much more definite. General opinion seemed to be that any move to increase support for research in industry would be most welcome but the effect of the program would depend in large measure on the amount of funding. Stressed was the extremely high cost of doing competent research and development on today's advance weapons systems and the very large disparity between the percentage of available funds devoted to this area in Canada as compared with the policy of substantial support for competing U.S. firms.

The reservations notwithstanding, the prospect of additional support to enhance the industry's competitive position contributed to what can reasonably be described as an air of cautious optimism on the industry's side of the house.

Once again, retiring President Wood sounded the keynote in his report. After brief reference to the uncertainty which followed drastic reductions in procurement of military equipment a few years ago he was "happy to report now that the picture is considerably brighter and the industry is operating at a higher level of activity than was expected."

Retiring Industrial Council Vice-President Stephenson echoed this view in a press interview.



**FULL DHC RANGE.** Republic of Ghana livery graces fuselages of complete range of de Havilland of Canada STOL transports. From camera away are Caribou, Otter and Beaver. To date Ghana has placed orders for 14 Beavers, 12 Otters and eight Caribou.

"We are in better shape than we had any reason to believe was possible two or three years ago."

There were unquestionably areas where further improvement was necessary. On production sharing, for example, there was still a sizable gap between the value of Canadian purchases in the U.S. and American orders to Canadian firms (for 1960 a total of \$196,000,000 Canadian expenditure in the U.S. as compared with \$113,000,000 of the American defense budget spent in Canada).

### Seek Balance

But steps are being taken to bring the two into balance, which was the goal AITA members felt would be reasonable.

D. N. Kendall, president of Hunting Survey Corp. Ltd., who served as honorary secretary of the association during the past year and remains on the board of directors, pointed out that discussions with representatives of government research agencies indicated there would be more attention directed toward specific environmental problems of Canadian operators. This would be of considerable assistance to the operator members and could lead to products and techniques which would be in demand on the world market in areas where similar conditions are encountered.

With the new emphasis on support of industry research and development providing assurance of a technically competitive posture for future markets the industry could well afford to

take heart at the present general level of activity.

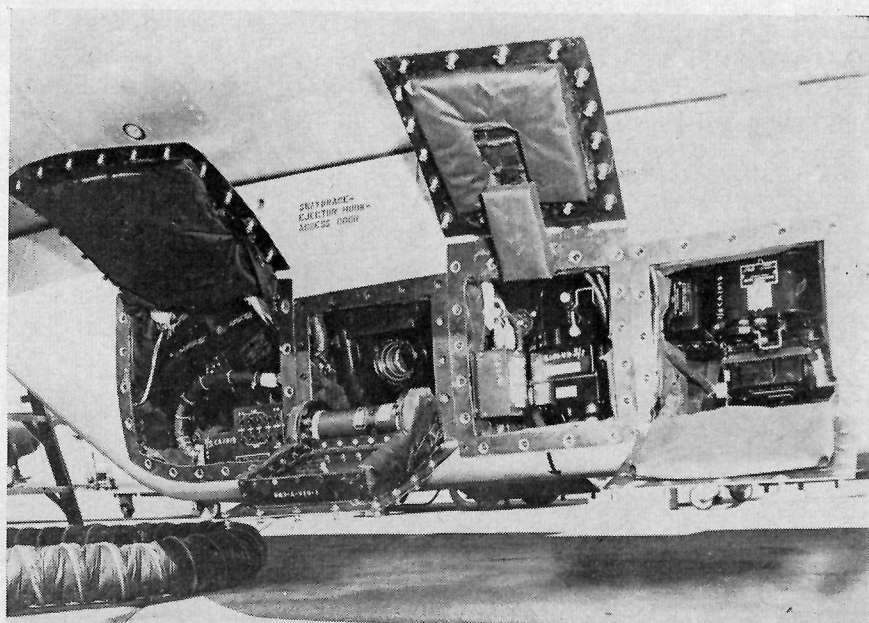
On the basis of present programs and projects moving towards production the indications are that the current year will see a reversal in the recent trend of industry gross sales which have declined from a peak of \$461,971,261 in 1958 to \$308,190,203 for 1960.

Among the main contributing factors are the move into high gear on production of the Canadair-built CF-

104 for the Royal Canadian Air Force and NATO customers; the continuing unique success of de Havilland Aircraft of Canada in the rugged STOL field; the RCAF order for the Canadair CL-41 ab initio jet trainer.

### \$620 Million Program

The CF-104 project represents a total \$620,000,000 program, of which \$420,000,000 is for aircraft to re-equip the RCAF's Air Division and



**CF-104 RECONNAISSANCE SYSTEM.** Developed for the RCAF to fulfill the role scheduled for its Super Starfighters in Europe prototype photographic reconnaissance pod and system has been successfully test flown at Palmdale, Calif. Photo shows the under belly pod and system installation with hatches open. Pod configuration was designed by Lockheed Aircraft. Prototype VICOM system was developed and produced by Computing Devices of Canada and W. Vinten Ltd. of London, England.





**AITA BOARD.** Directing activities of Air Industries & Transport Association during coming year, left to right, front row: H. D. Cameron, Canadian Pacific Air Lines, Vancouver; Honorary Treasurer; J. A. M. Austin, Austin Airways Ltd., Toronto, Vice-President Transport; Frederick R. Kearns, Canadair Ltd., Montreal, President; W. S. Haggett, Bristol Aero-Industries Ltd., Montreal, Vice-President Industry. Back row, John H. Baldwin, Honeywell Controls Ltd., Toronto, Honorary Secretary; James Wood, Rolls-Royce of Canada Ltd., Montreal; Victor Koby, Field Aviation Co. Ltd., Toronto; A. M. Cameron, Fairey Aviation of Canada Ltd., Dartmouth, N.S.; D. N. Kendall, Hunting Survey Corp. Ltd., Toronto; D. N. Watson, Pacific Western Airlines Ltd., Vancouver; Gerry Burnett, Matane Air Services Ltd., Matane, Que. Missing from the above photo is J. E. Wells, MCA, Ottawa.

\$200,000,000 is for the NATO order. Approximately 350 aircraft are involved; 200 to go to the RCAF and 150 for NATO.

Bringing the highly advanced Lockheed designed CF-104 and its sophisticated weapons system into production in Canada was a stimulating shot in the arm for the then sagging Canadian aviation industry. The program not only sharpened the capabilities of many Canadian facilities, but also opened a number of doors to subcontracting from U. S. sources made aware what the Canadian industry could accomplish as a result of CF-104 system licensing negotiations.

In addition a number of Canadian companies have received substantial export orders for CF-104 system equipment from other countries which are building their own version of the aircraft.

### 104 Program Exports

The wide acceptance of the basic Lockheed 104 design has also meant additional work for Canadair which has a contract to manufacture the aft fuselage, wings, empennages on all 104s built by Lockheed in supplying initial batches of aircraft to countries placing orders and subsequently mounting their own production lines.

At de Havilland of Canada the success story of the past decade is having new chapters added with continued world-wide acceptance of the company's STOL products. Prime customer continues to be the United States

Army which is now adding a steady stream of twin Caribous to its already substantial Beaver and Otter fleet.

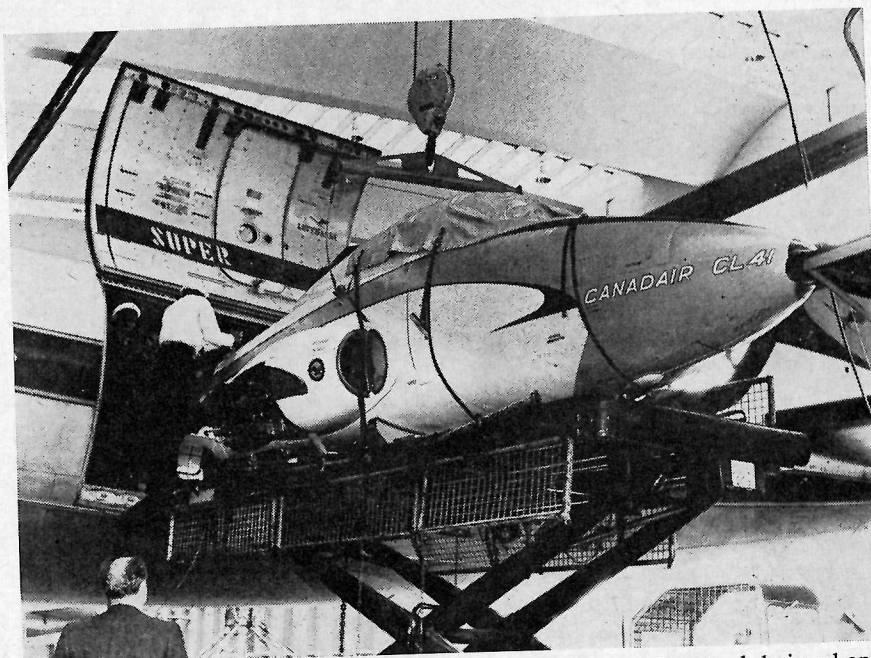
A highlight for the industry, and in particular Canadair, during the year was the order for CL-41 ab initio jet trainers for the RCAF. Stimulating as this order for 190 aircraft was in itself, its full significance lies in the fact that it was the key to getting Canadair and the Canadian industry into production on an aircraft which has aroused considerable interest in West Germany, Belgium, Holland, Switzerland and Sweden — all of which have

training requirements the CL-41 can fill.

West Germany, Belgium, Holland and Switzerland are seen as prime prospects for the CL-41R version of the aircraft, a weapons and navigation system trainer. The Swedish interest is in the basic training aircraft and the possibility here is for licensed production in the Scandinavian country.

### Forty Four Sales Show

The CF-104 program and the CL-41 prospects are the bright side of the



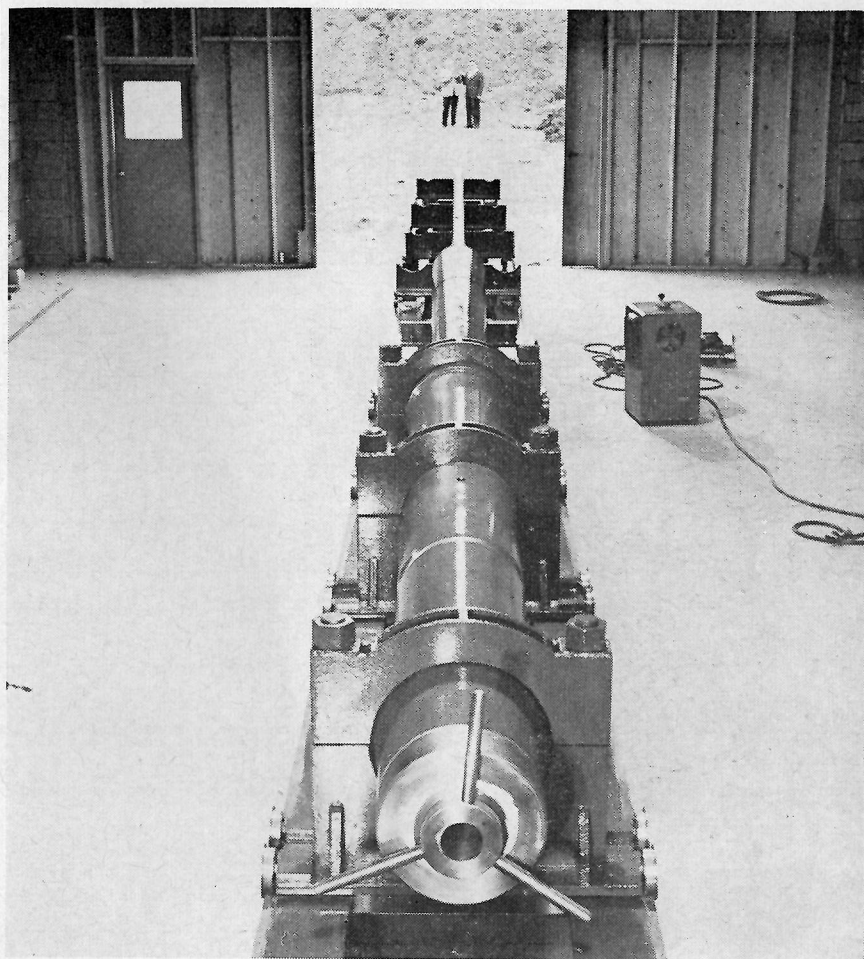
**EUROPEAN DEMONSTRATION.** Canadair sales efforts saw Montreal designed and developed ab initio jet trainer airlifted to Europe for extensive, well-received display.

coin at Canadair. There is a dull side, the inability to maintain pace on sales of the swing-tail CL-44 turboprop freighter. There are still possibilities of sales, with a prospective order from Lufthansa said to be close to a decision; but the program has not progressed at the rate necessary to maintain the line.

### Keep Line Going

An arrangement with the government under which there was a tentative order for five swing-tail aircraft for the RCAF on the understanding that Canadair itself would finance building of another five, with all aircraft being available for commercial sales if orders were received, has kept the line going. But so far no further concrete commercial sales, despite a determined effort to have the government persuade Trans-Canada Air Lines to switch a proposed order for the combination passenger/freighter Douglas DC-8F to the all-freight CL-44.

Forty Fours are now in service with three of the worlds largest air freight carriers — Flying Tigers, Seaboard World and Slick. Initial reports on performance have been good; it could be that in-service demonstration of the Forty Four's capability will generate the sales breakout for which Canadair is pressing so hard.



**FIRST IN NORTH AMERICA.** Light gas gun being installed at Computing Devices of Canada's new aerophysics research laboratory at Stittsville, Ont., will be the first such privately owned facility in North America engaged in study of space technology.

## Blazing Space Research Trail

An Aerophysics Research Laboratory incorporating equipment which will make it the first privately owned facility of its kind in North America engaged in the study of space technology is being built by Computing Devices of Canada Ltd. on a 200 acre site at Stittsville, some 15 miles west of the company's main plant at Ottawa. Making the first public reference to the project, CDC President and General Manager C. F. Hemberry expressed conviction that "regardless of Canada's ultimate role in aerospace activity, we must enter this field now to keep up with the state of the art. While Canada at this time does not have any major high-speed aircraft, missile or space development program, it is considered essential that CDC participate in and establish a reputation in the field of aerospace technology."

Operation of the facility will be based on six year's experience by CDC scientific personnel while employed on government sponsored aerophysics research

programs (mainly in connection with projects at Canadian Armaments Research and Development Establishment at Valcartier, Que.).

Completely CDC financed the facility will provide latest known launching equipment. Both company sponsored and contract supported basic research projects are anticipated. Among the fields to be investigated: impact and penetration; winged vehicle stability; plasma radiation and communications; high-G telemetry.

In addition, the facilities are seen to have excellent potential in applied research. What are described as several interesting combinations of gun launching and high-G electronics techniques are under investigation.

One such is the possible launching of vertical probes. Recent studies have shown that by proper selection of aerodynamic shape, instrumented vehicles can be fired vertically from smooth-bore propellant or light gas guns and achieve altitudes between 200,000 and 500,000

feet. Such a vehicle can transmit data on atmospheric conditions or perform a number of desired tests. Since a complete launch complex of this type is extremely simple, the technique has the potential of providing an extremely useful sounding or probe program at nominal cost compared to the use of solid or liquid propellant boosters. Firing rates of eight to ten shots per day are said to be possible with the equipment.

There is further the possibility of using these devices for high altitude anti-aircraft defence with possible extensions using gun-launched rocket techniques.

The initial launching equipment in CDC's new laboratory consists of a number of four inch smooth-bore guns which, with solid propellant charges, will permit tests of various projectiles and vehicles at speeds up to 8,000 ft./second and a light gas gun with interchangeable barrels of varying bore between one-half and two inches in diameter capable of launch speeds up to 30,000 ft./second.