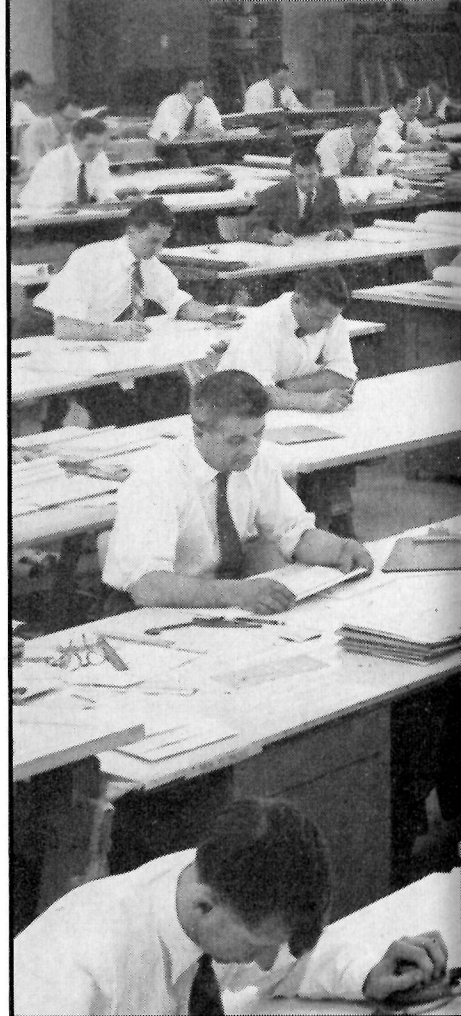


a report on the state of **THE CANADIAN AIRCRAFT INDUSTRY**

By ROBERT G. HALFORD



STATISTICALLY, Canada's Aircraft Industry was never in better health. Here are the figures to prove it:

The Industry is now operating some 12,000,000 sq. ft. of plant space, an increase of nearly half a million square feet since January 1957. Overall employment is holding firm at around the 46,000 mark. Employment at some individual firms is at a peak; Canadair, as an outstanding example, has over 10,000 employees on its payroll, a high for recent years.

Exports of Canadian manufactured aviation products (excluding Mutual Aid shipments) were an impressive \$55,000,000 in 1956 and \$44,000,000 in 1957. The current year will probably see exports by this Industry exceed \$100,000,000, an all-time high, with the balance of the Belgian and West German order for, respectively, CF-100's and Sabres, will be delivered during this period.

The Canadian Aircraft Industry has 12 separate types of aircraft, two reciprocating and two turbojet engines

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Canadian Aircraft Industry facilities range from research to engineering design (above) to production (lower L).

in production or in prototype construction status. In addition, design work is proceeding on a small turbojet.

After considering these facts, it does not seem unreasonable to repeat: Statistically, Canada's Aircraft Industry was never in better health.

Misleading

UNFORTUNATELY, no industry can live on statistics, especially when they are a record of past and present glories. The past is gone and the present is on its way. Statistics may or may not be harbingers of the future. In this case, the statistics can be interpreted in two ways: either they show that the Industry is like one of those cartoon characters who continues swimming blithely high in the air because he has not yet become aware that the crest of the wave has rolled out from under him; or they indicate that the Industry is about to enter a long period of prosperity, during which Canadian aeronautical technical prestige will reach new heights.

It is difficult to decide at this point,

into just which of these two categories the Canadian Aircraft Industry does fit. There are many factors which must be considered in arriving at an accurate decision. For instance, the very multiplicity of the projects that the Industry currently has in hand is quite misleading.

Let's take a clear look at these several projects. It will be seen that the essential hard core of production aircraft on which the Industry depends for its daily bread and butter, comprises no more than four types which still have any sort of a reasonable production run ahead of them. And it is of some significance that only two of these aircraft are essentially for the Canadian Government (one for the Air Force, and one for the Navy). Further, just one type of powerplant, a reciprocating engine, is being produced under Government contract.

Of the 12 separate types of aircraft mentioned, three (the Sabre, the T-33 and the CF-100) are nearing the end of their production life. The days of the Sabre and the T-33 in particular are

definitely numbered. Stretchouts and a recent small new order will keep the CF-100 going for a while longer, but at a very low rate of production.

Of the remaining nine projects, three are new designs, only one of which — the de Havilland DHC-4 Caribou — at this moment seems reasonably sure of an extended life. In the case of the other two — the Avro CF-105 Arrow and the Canadair CL-41 Trainer — there is no assurance that either will ever go into service. The Arrow program is authorized only until next October, when a long hard look is to be taken at missile developments *vis-à-vis* the manned bomber.

The CL-41 is a private venture initiated by Canadair Ltd. Two prototypes are being constructed, but unless RCAF backing is forthcoming, it is unlikely that the program will proceed beyond the prototype stage. RCAF backing depends on the existence of a requirement in the Air Force's pilot training curriculum for a jet trainer of the same general description as the CL-41.

Aviation Imports to Canada: 1953-1957

FROM THE UNITED STATES

	1953		1954		1955		1956		1957-10 Mos.	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
AIRCRAFT										
Not over 1,500 lbs.	138—	\$ 357,858	130—	\$ 315,395	158—	\$ 435,461	263—	\$ 971,068	262—	\$ 1,182,834
1,501-3,000 lbs.	85—	737,358	63—	584,555	136—	1,156,620	129—	1,438,125	129—	1,446,167
3,001-7,500 lbs.	70—	3,793,756	26—	2,679,715	33—	2,797,797	31—	2,196,392	25—	1,020,379
Over 7,500 lbs.	80—	15,576,442	16—	8,513,577	100—	38,003,385	64—	11,113,256	29—	4,334,515
AIRCRAFT ENGINES										
Up to 200 hp.	216—	\$ 219,916	182—	\$ 206,725	222—	\$ 431,938	313—	\$ 381,716	308—	\$ 289,391
201-500 hp.	274—	576,458	82—	192,656	219—	755,087	207—	618,683	211—	583,560
501-1,000 hp.	48—	233,546	74—	631,638	39—	410,872	66—	481,228	75—	334,467
Over 1,000 hp.	329—	10,793,891	119—	4,650,845	454—	8,255,665	461—	10,167,341	308—	7,911,919
AIRCRAFT PARTS		\$ 82,527,323		\$ 83,483,241		\$ 82,190,126		\$ 68,464,833		\$ 59,347,708
ENGINE PARTS		\$ 18,381,992		\$ 16,888,349		\$ 14,430,730		\$ 16,199,199		\$ 13,691,354
AVIATION GASO- LINE		79,861,231 gals. worth \$ 16,305,335		81,556,477 gals. worth \$ 16,548,880		106,475,884 gals. worth \$ 21,593,087		99,363,673 gals. worth \$ 20,516,931		93,845,197 gals. worth \$ 19,349,119
TOTALS, by years		\$150,503,875		\$134,695,576		\$170,460,768		\$132,748,772		\$109,491,413

FROM THE UNITED KINGDOM

	1953		1954		1955		1956		1957-10 Mos.	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
AIRCRAFT										
Not over 1,500 lbs.					5—	\$ 7,000	1—	\$ 500	1—	\$ 3,309
1,501-3,000 lbs.					1—	3,750	1—	750		
3,001-7,500 lbs.	5—	\$ 239,984			2—	88,562			5—	308,111
Over 7,500 lbs.	8—	2,421,804	2—	696,552	25—	8,644,278	4—	2,965,967	11—	8,246,168
AIRCRAFT ENGINES										
Up to 200 hp.					4—	\$ 2,000	6—	\$ 5,072	3—	\$ 16,045
201-500 hp.	20—	139,915	9—	35,147	5—	5,467	11—	51,049	4—	5,314
501-1,000 hp.	1—	9,863			4—	34,093	1—	6,089		
Over 1,000 hp.	366—	9,694,006	302—	7,082,606	273—	5,348,149	51—	1,026,513	64—	1,929,554
AIRCRAFT PARTS		\$ 4,950,271		\$ 4,039,508		\$ 4,386,065		\$ 3,843,443		\$ 4,346,974
ENGINE PARTS		\$ 6,243,004		\$ 4,956,896		\$ 3,670,944		\$ 3,919,425		\$ 5,322,942
TOTALS, by years		\$ 23,698,847		\$ 16,810,709		\$ 22,190,308		\$ 11,818,808		\$ 20,178,417

FROM ALL OTHER COUNTRIES

	1953		1954		1955		1956		1957-10 Mos.	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
AIRCRAFT, all sizes		4—\$ 67,166				10—\$ 279,715		6—\$ 193,440		3—\$ 63,584
AIRCRAFT ENGINES all sizes		14—\$ 83,565				16—\$ 65,157		8—\$ 51,359		3—\$ 48,085
AIRCRAFT PARTS		\$ 130,718		\$ 84,488		\$ 98,530		\$ 116,145		\$ 91,588
ENGINE PARTS		\$ 20,967		\$ 2,994		\$ 5,067		\$ 10,328		\$ 917
AVIATION GASO- LINE				1,030,325 gals. worth \$ 243,647		2,392,368 gals. worth \$ 527,994		3,742,521 gals. worth \$ 839,350		941,192 gals. worth \$ 230,798
TOTALS, by years		\$ 302,416		\$ 331,129		\$ 976,463		\$ 1,200,622		\$ 434,972

TOTAL VALUES OF AVIATION IMPORTS TO CANADA, BY CLASSES

	1953	1954	1955	1956	1957-10 Mos.
Aircraft	\$ 24,194,368	\$ 12,789,794	\$ 51,416,568	\$ 18,879,498	\$ 16,605,067
Aircraft Engines	21,751,160	12,799,617	15,308,428	12,794,433	11,118,335
Aircraft Parts	87,608,312	87,607,237	86,674,721	72,424,420	63,786,270
Engine Parts	24,645,963	21,848,239	18,106,741	20,128,952	19,015,213
Aviation Gasoline	16,305,335	16,792,527	22,121,081	21,356,281	19,579,917
TOTALS, all aviation imports	\$174,505,138	\$151,837,414	\$193,127,539	\$145,583,584	\$130,104,802

(Source: Dominion Bureau of Statistics)

The remaining six projects are all production aircraft. However, even here the total can be adjudged misleading. Two of these aircraft, the Canadair CL-44 and CL-66 transports for the RCAF, are so far the subject of what can best be described, numerically, as token orders.

More substantial are orders for the four other aircraft in this group: the Beaver, the Otter, the Tracker, and the Argus. The Beaver and the Otter, of course, have an apparently indefinite production life. The Tracker, on the basis of existing orders is good for at least two more years. There also remains the possibility that Canada may contribute some Trackers to Mutual Aid for service with other NATO countries, in which case production would be extended. Deliveries of the Argus have only just begun, so with 50 reportedly scheduled for RCAF service, orders should be sufficient to keep the assembly lines active for some time to come.

The picture in the allied aircraft engine industry bears a close resemblance to that for the airframe side.

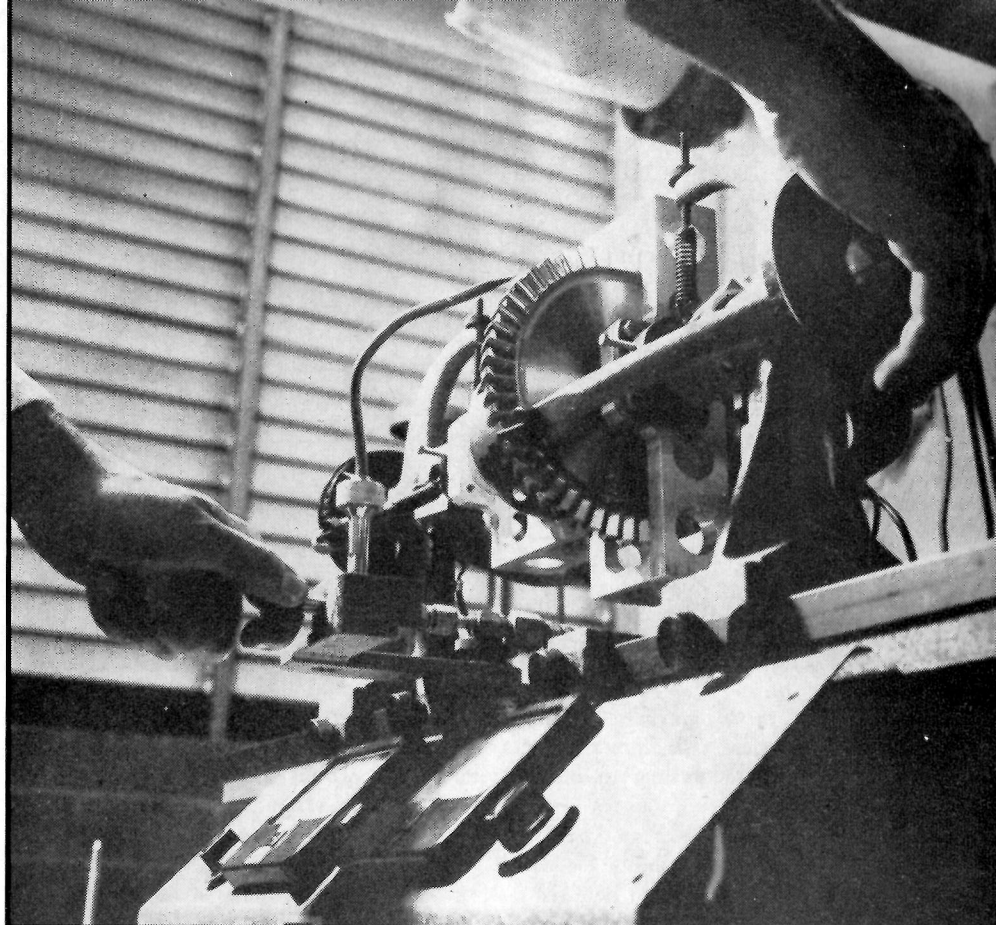
The R-1820 Cyclone being manufactured under license by Canadian Pratt & Whitney is assured of continued production for a satisfactory period, while the R-1340 Wasp, made in the same plant, is now in only nominal production. It is also Canadian Pratt & Whitney which is working on the design of a small turbojet in the 2,000 lb./th. range. A private venture, this is not far enough advanced to be significant at this time.

The Orenda jet engine is still being produced in some quantity, but with the end already in sight for the Sabre, and within the foreseeable future for the CF-100, the Orenda's importance as a production item is diminishing rapidly.

The Orenda Iroquois is a project of great promise, but its future depends largely on the future of the CF-105 Arrow, a subject which has already been dealt with in a preceding paragraph.

Long Range Planning

ONE DOES not have to mull over the foregoing recapitulation very long before arriving at the conclusion that the course Canada's Aircraft Industry will follow in the future depends on two things: the role of the manned military aircraft as a defensive



Design and manufacture of all types of precision equipment is undertaken by Canadian firms. Above, balancing a turbine pump rotor at Lucas-Rotax Ltd.

weapon, and the introduction by the Canadian Government of a long range plan for the Industry.

By way of mitigation, it might be said that lack of the latter may be credited to uncertainty about the former. It might also be pointed out that while the recent arrival of the aeronautical sciences at a technological crossroads has provided Government planners with a ready excuse for not introducing a long range plan, such a plan never existed even in times when the one and only air defence weapon was the airplane *per se*. Nor is there any indication that a long range plan for Canada's Aircraft Industry will be forthcoming when the respective roles of the airplane and the missile become clear.

But if Government planners feel that uncertainty about the future of the manned military aircraft as a defensive weapon prevents them from committing themselves to even a rudimentary long range plan, leading industry executives are not plagued by doubts about future trends in military aviation.

As one company executive succinctly put it, "if political ends are still to be sought by the threat of military means, we must continue to consider every de-

fensive and offensive device likely to be effective. First-line aircraft may thus be no more obsolete in the missile age than knife-wielding Commandos were in the days of the rocket-firing Typhoons and V-weapons."

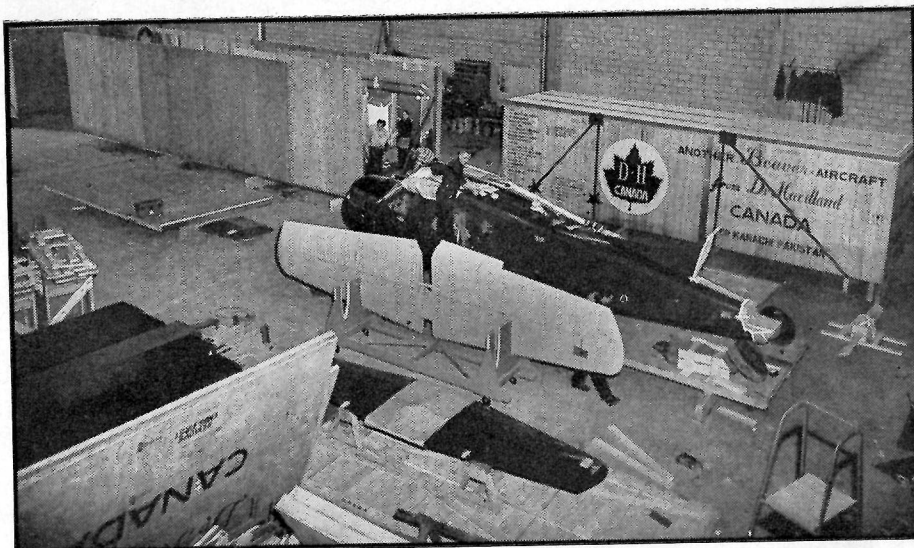
J. G. Notman, president & general manager of Canadair Ltd., states flatly that "it is entirely premature to write the epitaph for the manned aircraft."

Discussing the future of military aviation for *Aircraft* recently, Mr. Notman had this to say:

"The main problem in North American defence is the existence of wide avenues of approach as well as numerous key areas which must be defended.

"At the present time our surface-to-air missiles cannot be our sole defence since they have a relatively limited range, and a sufficient number of installations to defend all key points would be prohibitively expensive. Until these are superseded by a surface-to-air missile of greater range, the manned aircraft will be the chief defence of the North American continent.

"Recent estimates of Russian strength specify about 30,000 aircraft of all kinds, and about 600 submarines. Moreover, there are indications of increased Russian emphasis on the nuclear-pow-



Export business is big business at de Havilland Canada. Shown crated or being crated for shipment to four different countries are two Otters and two Beavers.

ered missile-carrying submarine. Against these two known threats, the aircraft will continue to play a vital role.

"Limited or Korean-type wars are still a distinct possibility for which we must be prepared, and here the task of close support, rapid mobility and pinpoint attack are best performed by manned aircraft.

"We can also anticipate the development of new types of military aircraft such as nuclear-powered planes capable of cruising aloft for long periods and serving as a missile-launching base.

Along the same lines is what John L. Plant, executive vice president and general manager of Avro Aircraft Ltd., has to say: "Public statements of defence officials and military leaders during the past year have indicated that the manned military aircraft will be a necessary and useful weapon for the foreseeable future, and that missiles and manned aircraft are destined to play complementary, rather than mutually exclusive, roles in the defence picture.

"In the long range future when this situation is attained, it would seem logical to expect that the *quantities* of manned aircraft of all types will diminish as missiles come into operational status to fulfil their particular place in the overall defence system."

Less Glamor

IT MAY BE assumed from these statements that while the manned first-line military aircraft, such as those in the interceptor category, will form a major part of Canadian production over the next ten years, the more distant future of Canada's Aircraft

Industry will probably depend on less glamorous, but more enduring items. This would include civil, as well as military aircraft.

R. T. Riley, president of Canadian Pratt & Whitney Aircraft Co. Ltd., a company that does a healthy business in the export and civil markets, notes that "we believe there will be a steady reduction of Canadian procurement of manned military aircraft of the purely defensive type. On the other hand, we would hope this would be offset by the procurement of military trainers, transports, helicopters, and ground support aircraft for use in support of small scale military operations. We believe the overall volume of Canadian military aircraft procurement in the next few years will be well down from the recent peak levels, but that it will climb again with a gradual change in the nature of requirements.

"We also believe the export field presents good opportunities for the sale of general purpose and specialized aircraft products though not, we think, at the top of the scale in either size or performance, where the price of competition is too high for such a small home market."

The importance of this export market for both military and civil aircraft and engines, cannot be underestimated. In the case of such large firms as Canadian Pratt & Whitney and de Havilland Canada, export business makes up a major portion of their volume. And though export does not form such a vital proportion of Canadair's gross sales as in the case of the two smaller companies, the total dollar value of foreign sales of Sabres in recent years undoubtedly is very high. A similar

story could be told about Orenda's place in the export market, and more recently, Avro Aircraft got into the export field with the sale of CF-100's for the Belgian Air Force.

Less tangible, but nevertheless as financially profitable as the export of aeronautical hardware, is the export of aeronautical ideas. The most notable example of this is the recent deal between Orenda Engines and Curtiss-Wright, giving the U.S. firm the right to manufacture and develop the Iroquois turbojet in the U.S. Similarly, Avro is active in this "idea" export market with its VTO design studies for the USAF.

At the same time, it is evident that the continued success of Canada's Aircraft Industry on the foreign market depends entirely on the continued existence of a domestic military and civil market. Practically all the aviation products which Canada is selling abroad, were originally developed to meet specific Canadian military or civil requirements. There is little doubt about future trends in the civil market, but the military situation must soon be clarified if the Industry is going to capitalize on the footholds it has gained in the foreign markets. It is in the obvious self-interest of the Government to do all it can to smooth the way to the foreign markets for Canadian manufacturers of aviation products.

For example, in the CL-44 Liner and the CL-66 Cosmopolitan, Canadair Ltd. has two excellent contenders for the world airline market. Neither of these aircraft would be available for sale abroad had they not first been ordered by the Government to fill RCAF requirements for new long and

Aviation Exports from Canada: 1953-1957

(Does not include Mutual Aid Shipments)

AIRCRAFT

DESTINATION	1953		1954		1955		1956		1957	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume
Alaska	4—	\$ 147,232			1—	\$ 36,808	3—	\$ 122,933		
Arabia			2—	\$ 78,588	1—	41,755	1—	45,087	8—	\$ 357,100
Australia			4—	136,936	2—	51,253	1—	55,734	15—	8,544,000
Belgium									5—	483,505
Chile	9—	327,960	4—	157,410	7—	349,308	14—	2,494,722	2—	82,365
Colombia			1—	40,711	1—	44,426	15—	567,000		
Egypt	1—	39,472			3—	273,811			4—	195,912
Falkland Islands							4—	221,177		
Indo China			2—	15,583			2—	109,216		
Indonesia	4—	137,955			1—	41,029			1—	72,100
Japan			3—	44,165	2—	40,946	2—	18,500	2—	19,000
Mexico	2—	60,628	3—	74,949			2—	105,821		
New Zealand			6—	667,701			1—	79,198	1—	92,404
Norway	3—	112,977							4—	238,983
Pakistan					3—	238,630	3—	237,630		
Philippine Islands			1—	40,933			36—	10,808,971	1—	51,447
Union of S. Africa	341—	23,609,243	221—	11,222,578	170—	7,673,649	185—	11,334,963	139—	6,947,785
United States	1—	15,388					2—	93,240	1—	85,000
Venezuela									21—	6,720,000
West Germany	9—	195,296	3—	121,636	2—	57,842	10—	542,912	7—	395,873
Other Countries										
TOTAL, All Countries, by years	374—	\$ 24,646,151	252—	\$ 12,601,190	193—	\$ 8,848,952	281—	\$ 26,837,104	211—	\$ 24,285,504
RE-EXPORTS*	18—	\$ 313,559	13—	\$ 979,820	17—	\$ 326,165	34—	\$ 2,157,902	21—	\$ 477,272

AIRCRAFT AND AIRCRAFT ENGINE PARTS

DESTINATION	1953	1954	1955	1956	1957
Australia	\$ 8,683	\$ 34,443	\$ 60,509	\$ 36,615	\$ 54,083
Belgium	87,170	9,421	56,979	37,710	27,987
Brazil	166,943	158,299	35,706	45,281	14,498
Chile	54,126	45,137	2,061	28,713	63,856
Colombia	54,031	36,987	81,349	466,041	462,496
Egypt	9,454	14,602	61,084	56,127	5,743
France	72,250	22,714	21,802	20,747	26,377
India	121,735	123,203	200,922	521,343	118,489
Japan	36,904		201,951	135,716	279,410
Morocco	268	206,967	476	278	44,849
Netherlands	5,621	69,103	63,386	72,229	7,236
Norway	22,663	153,271	22,059	100,646	63,376
Philippine Islands	14,906	70,607	1,031	22,094	26,212
Turkey	65,067	37,213	1,196		6,752
Union of S. Africa	56,838	96,366	60,768	3,428,443	324,801
United Kingdom	1,518,453	674,596	188,274	156,526	162,549
United States	12,906,162	13,900,336	9,816,381	17,276,175	9,189,710
Venezuela	9,677	144	16,723	44,175	71,364
West Germany	32,951	3,729	5,770	19,516	4,387,366
Other Countries	356,454	283,920	158,406	239,328	287,556
TOTAL, All Countries, by years	\$15,600,356	\$15,841,058	\$11,056,833	\$22,707,703	\$15,624,710
RE-EXPORTS*	\$ 4,825,410	\$ 3,309,303	\$ 1,792,906	\$ 3,419,288	\$ 3,833,951

	1953	1954	1955	1956	1957
TOTAL EXPORTS, Aircraft and Parts	\$40,246,507	\$28,442,248	\$19,905,785	\$49,544,807	\$39,910,214
TOTAL RE-EXPORTS* Aircraft and Parts	5,138,969	4,289,123	2,119,071	5,577,190	4,311,223
TOTAL, All Aviation Exports	\$45,385,476	\$32,731,371	\$22,024,856	\$55,121,997	\$44,221,437

*Re-exports concern foreign-made products which have been imported to Canada and then, during the period under review, exported again.

Source: Dominion Bureau of Statistics

medium-range transports.

One phase of the domestic civil field which has not in recent years been fully exploited, is the airliner market. As one Canadian executive commented to *Aircraft*: "Unfortunately, the Canadian aircraft manufacturing industry depends too much on military contracts. It seems that most of our over 100 four-engine transports purchased in recent years came in either from the U.S. or Great Britain. This is a pity, because we missed a wonderful opportunity to put our aircraft industry in proper shape and at the same time capture a greater export potential. Better co-operation among the interested parties certainly would have kept part of this business in Canada."

Accessory Manufacturers

NO MENTION has been made so far of one of the most important components of Canada's Aircraft Industry . . . the accessories and parts manufacturers. Compared to this ancillary group, the health of which is essential to the self-sufficiency of the Industry, the major airframe and engine contractors lead a sheltered life.

The most common complaint of the Canadian secondary industry is that, unlike the large contractors, they are expected to compete directly with U.S. manufacturers, while receiving little or no support on new products from the engineering point of view. Although development costs are granted to the Canadian prime contractors, it is the exception rather than the rule that development costs are allowed to the Canadian accessory manufacture for any new products.

By way of contrast, the U.S. industry is protected by the so-called "Buy America" Act, and if a foreign company is bidding for a U.S. contract, it has to be at least 6% better than the lowest U.S. bidder, and, in some cases, as much as 22% lower.

In most cases, the U.S. companies have already had their design and developments costs paid for and if they have not, they are in a very much better position to amortize these costs against a larger volume of production than Canadian companies are.

One leading Canadian equipment manufacturer doing business in the aviation field says that "the situation has improved considerably, in that the

The prime hazard faced by a designer of modern military aircraft—that swiftly advancing arms technology may wipe out the requirement for his product before he can get it into operational form—is nowhere better illustrated than in the case of the Avro CF-105 Arrow.

At the moment, Government backing of the Arrow is assured only until next October, at which time defence planners will take a look at the most up-to-date intelligence reports to see if any solid evidence has yet been uncovered to show that the U.S.S.R. is actually abandoning the manned bomber as a long-range weapon.

Meanwhile, Avro Aircraft is proceeding with the development program, at the same time making studies to determine how the Arrow could serve even in the ICBM age. One application seriously advanced has been to use it as an anti-missile missile carrier. Avro Vice President Engineering James Floyd has pointed out that an anti-ICBM missile launched at 60,000 ft. by an aircraft flying at Mach 1.5 has a much greater chance of making a successful interception than one launched from a ground level standing start. What's more, an anti-ICBM missile launched under such circumstances would require only one-third as much thrust as a ground-launched missile to accomplish the same task.

At time of writing, the first Arrow 1 was on the verge of starting its high speed taxi trials (up to 160 kts.), any one of which could mark the beginning of this impressive all-weather supersonic fighter's maiden flight.

It is understood that the pre-production batch of Arrows comprises five Arrow 1's (including the one now being readied for flight),

and three Arrow 2's. The former are, of course, the version powered by the Pratt & Whitney J-75 of some 20,000 lb. th. (with reheat).

The Arrow 1's, it has been indicated, are essentially powered airframes only; that is, they lack all number of important components in the area of armament, automatic fire control and navigation. The Orenda Iroquois-powered Arrow 2 should, on the other hand, be representative of the operational Arrow Weapon System, complete in all its complexities.

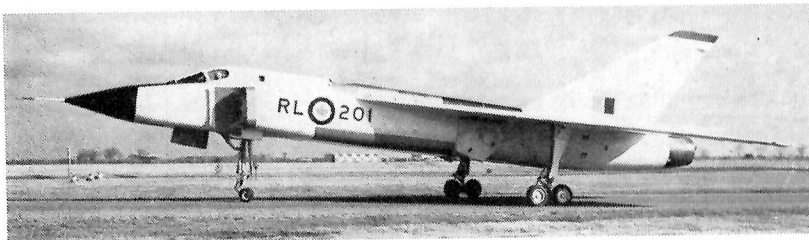
From the very start, these aircraft have been built with production-type tooling. Thus, if the Government decides to press on with volume production of operational aircraft, work will be able to proceed without the agonizing delays so familiar in the days when nobody thought of starting on production tooling until the hand-built prototype had been proven out.

There have been frequently recurring, but unconfirmed, reports that orders have already gone out to suppliers and subcontractors for enough parts to put together up to 40 aircraft.

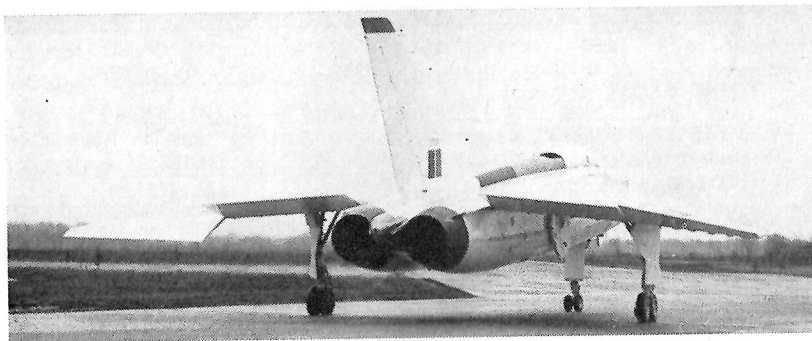
Official statements have referred to a speed in the nature of Mach 2.0, an operational ceiling of over 60,000 ft., and a range of about 1,500 miles. It is thought that the actual operational ceiling is approximately 65,000 ft.

Avro officials have stated flatly they are interested in taking a crack at the absolute speed record with the Arrow. Since there are now several U.S. military aircraft which can attain Mach 2.0, it might be surmised that Avro would not speak of breaking speed records with such confidence unless they knew the Arrow could easily exceed double Mach by a comfortable margin.

AVRO ARROW



The Arrow 1 is shown during its low speed taxi trials at Malton. Before starting high speed trials, aircraft was completely stripped and inspected.



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AIRCRAFT INDUSTRY . . . Cont.

prime contractor, at any rate, has realized the importance of supporting the accessory manufacturers in Canada; but although the Government have indicated they will fully support the smaller manufacturer, nothing in a very practical form has been forthcoming and, in fact, we are still burdened with the necessity of having to compete directly with U.S. competition."

In a similar vein, another large equipment maker states: "Prime contractors and the Canadian Government do, up to a point, encourage Canadian production of equipment and components. However, I would suggest that no one has made any real attempt to define what is meant by 'Made in Canada', and to determine what should be considered a proper theoretical premium to pay for Canadian made goods as against, for example, those made in the U.S. Some premium is obviously economically practical from the standpoint of Canadian employment, corporate and personal taxes and the development of Canadian know-how."

And this is the view of a small contractor in the aviation equipment field:

"What hope has a Canadian accessory manufacturer, even when allowed a small premium, of competing against U.S. and U.K. companies who have already (a) designed, and (b) tooled up, and written off either one or both of these charges against other contracts?"

"The Government, no doubt, appreciates the predicament, and may have decided they cannot afford to support a complete aircraft industry in Canada, but can they afford to allow existing facilities and skills which are available for an emergency to fade away? Is it better to keep prime contractors working at say 70% of capacity, and have accessory manufacturers dying a lingering death, or is it better to have both working at say 60% of capacity? This may be a little more costly to the Government, but is cost the deciding factor?"

Indian Giving

THE SOMETIMES heard complaint that prime contractors have a habit of taking back work from subcontractors whenever work begins to get slack in the larger company's

DHC CARIBOU.....

In midsummer of this year, the de Havilland DHC-4 Caribou is scheduled to make its first flight.

Though design studies on the Caribou got under way about three years ago, it was not until nearly two years later that Government interest on behalf of the Canadian Army turned into an order for a prototype aircraft.

Further encouragement to de Havilland Canada came in the spring of 1957, when it was announced that an order worth approximately \$2,500,000 for five Caribou, had been placed for the U.S. Army, which wants the aircraft for evaluation purposes. The interest of both the U.S. Army and the Canadian Army springs from the same requirement: that is, for a STOL type aircraft capable of providing rapid transportation for ground forces within combat zones.

Designed with payload and STOL characteristics as primary considerations, the Caribou is regarded as a logical selection for the U.S. Army to add to its already large fleets of de Havilland Canada L-20 Beavers and U1-A Otters.

Basically, the DHC-4 Caribou is an all-weather utility transport aircraft. Primary purpose of the airplane is to serve as an army vehicle designed to provide rapid mobility

for troops, equipment and supplies in forward battle areas, and as a commercial transport intended to offer low-cost transportation of passengers and cargo in undeveloped areas.

The DHC-4 is designed to operate independently of established airport facilities and to be able to land or take-off from short, improvised landing strips.

A clear, unobstructed cabin is provided with direct access through large rear-loading doors, which also permit rapid jettisoning of cargo in airborne operations. An adjustable loading ramp and freight winching facilities provide for rapid loading and ensure a quick turn-around on the ground.

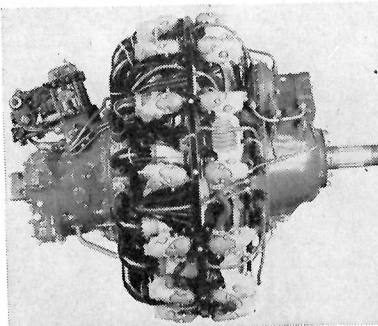
The structure is conventional, simple and rugged and is capable of absorbing a maximum of rough treatment with a minimum of field maintenance.

In keeping with the conservative nature of the project, a proven powerplant has been adopted. The Pratt & Whitney R-2000 is one of the most reliable aircraft engines in existence. A turboprop installation is a practicable consideration for the future development of the airplane.

The basic powerplant installation, the R-2000 D5, is the widely known Twin Wasp. It has 14 cylinder arranged in two rows of seven. Bore is 5.75 in. and stroke, 5.5 in. The propeller shaft is driven through a planetary reduction gear which has a ratio of 0.5/1. The single-speed supercharger has a ratio of 7.15/1.

The engine is rated at 1,450 hp @ 2,700 rpm @ 2,800 ft., for take-off. Normal rating is 1,200 hp @ 2,550 rpm. Weight is 1,570 lbs.

The Caribou at gross weight will have a passenger capacity of 27 seats. A strictly military bench seat arrangement will provide seating accommodation for 28 combat troops. As an ambulance airplane, a total of 22 standard army litters can be installed. Various combinations of stretchers and sit-up casualty cases and/or medical attendants are possible.



Above, the P & W R-2000 powerplant for the Caribou. Below, a Caribou scale model being tested under free flight conditions with the assistance of an Otter flying test bed. Technique is de Havilland developed.



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shops, does not appear to be a valid one, except possibly in the case of those firms which undertake to make airframe components (tailplanes, etc.) under contract.

The prime contractors claim that it just isn't so, and generally the parts makers back them up in this claim. The major firms point out that most of the items they subcontract in the first place are things that they aren't equipped to make themselves.

Canadair says that in its case, the value of subcontracts placed in 1957 represented a 30% increase over 1956, though this was not representative of the industry as a whole.

Commenting in general on subcontracting practices, Canadair President Notman says that "the volume of subcontract business placed by the prime contractors is affected by a number of complex factors such as scheduling of major programs, specialized equipment that may be needed, and other factors. . . .

"It is the policy of Canadair to give the optimum consideration to our subcontractors, since we are aware that a self-sufficient aircraft industry must be able to rely on a strong network of subcontractors.

"Very often, when subcontractors are working at only a fraction of capacity, prime contractors find themselves in no better position. . . .

"I feel that we have made a great deal of progress on the question of developing Canadian production of equipment and components. In fact, the single characteristic change in the Canadian Aircraft Industry over the past five years has been the development of many Canadian suppliers for items previously manufactured elsewhere."

Mr. Notman goes to the heart of the matter when he notes that "the major difficulty is that of being able to assure adequate volume to a potential supplier, but where this has been the case, I know that strong encouragement has been given and will continue to be given to Canadian suppliers. In addition, such a procedure provides easier contact and liaison for the prime contractor as well."

The manufacturer who does a good deal of trade in the export market has a problem which sometimes prevents him from giving business to Canadian

CANADAIR TRAINER

The latest news about Canadair's trim CL-41 Trainer project is that the Fairchild J-83 turbojet of over 2,000 lbs. thrust has been chosen to power the new aircraft.

The CL-41 is a basic pilot trainer which had been under consideration by Canadair for some time prior to the company's decision last November to proceed with the construction of two prototypes, as a private venture. Since that decision, Canadair reports, the design has continued to progress satisfactorily, with tooling advancing according to schedule and first assemblies already in the jigs.

A previously mentioned plan to make the Trainer design adaptable to a four-place executive aircraft has now been just about dropped.

In arriving at the basic proposal for the Trainer, Canadair's thinking ran something along the lines that modern military training is turning more and more to the use of all-jet programs from ab initio up to supersonic capability, and to side-by-side instruction for time-economy, efficiency and improved student evaluation.

The CL-41 has been designed to meet these and other advanced military specifications for training aircraft, Canadair says, as well as to take full advantage of the advanced state of the art reflected in today's light-weight high thrust jet engines.

"As a result," the company claims, "the CL-41 will surpass any competitive trainer; better take-off performance, unmatched span of operating speeds, better spin and recovery characteristics, superior range and endurance, altitudes to 40,000 feet and complete pressurization. At the same time the aircraft meets

the conventional trainer standards for weight, size and controllability."

Among the features of the Trainer are side-by-side seating; dual blind flying panels; automatic pilot escape system; provision for light armament and external stores.

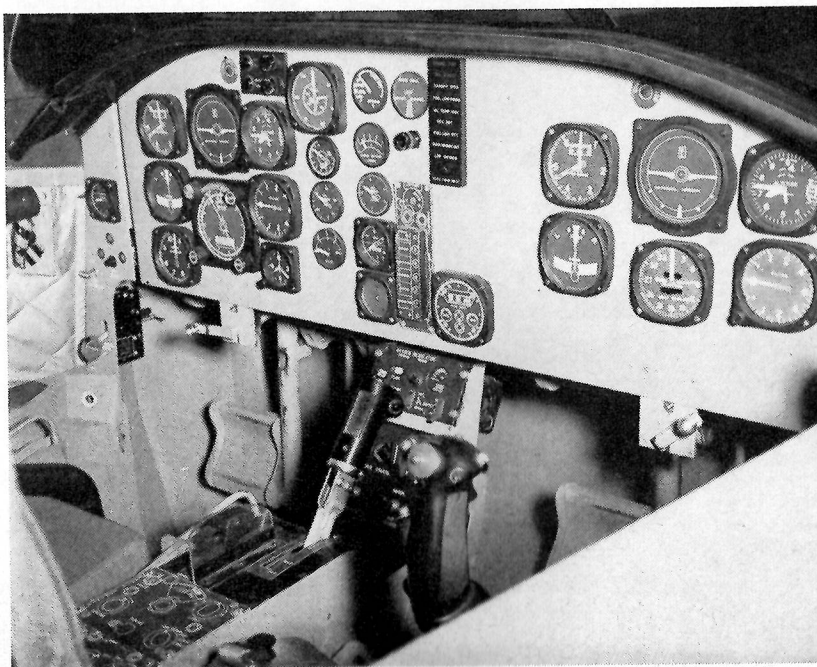
All the fuel is stored in the fuselage and this, coupled with other design features, are said to ensure good spin and recovery characteristics. In fact, Canadair says that spin tests conducted in the NAE's vertical wind tunnel in Ottawa with a one-fifteenth dynamic scale model indicate that the CL-41 spin and recovery characteristics satisfy both British and U.S. criteria. It is pointed out that since the two criteria differ appreciably in basic approach, it is considered an achievement that the CL-41 meets both.

Aircraft weight is 6,500 lbs. Performance data include a stalling speed of 63 knots; a maximum level speed of 400 knots and a maximum diving speed of 500 knots. Landing and take-off over a 500 ft. obstacle will be accomplished in less than 1,800 ft., according to performance estimates. Fuel capacity of 250 gallons will allow two hours of training circuits, or an 800 nautical mile flight at a speed of 300 knots.

The two prototype aircraft now under construction are scheduled for completion late in 1958, and first flights early in 1959.

Dimensions include a span of 36 ft. 4 in., a length overall of 31 ft. 11 in., and a height overall of 9 ft. ½ in.

The CL-41 project is under Edward H. Higgins, project manager; project engineer is Fred C. Phillips; project group leader, R. H. Lake. Responsibility for building the CL-41 is vested in Ralph G. Stopps, manufacturing manager.



Above is shown the cockpit of the engineering mockup of the CL-41 Trainer.

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R. B. BARNARD

suppliers. Canadian Pratt & Whitney President Riley says that his firm does everything practicable to use Canadian sources for purchased materials and parts, but "with so much of our business in the commercial and export fields . . . price is of paramount importance and in many instances our volume is not sufficient to permit a Canadian vendor to match the larger volume prices of a U.S. vendor."

Government Programs

IN THE FINAL analysis, though the Industry can do much to help itself, its future still depends, and will for some time to come, on programs initiated by the Government.

Will the future of the Industry be a continuation of the feast or famine cycle which has become so familiar? Or will the current breathing spell be utilized to formulate a long range plan? This remains to be seen. In any event, the possibility of getting a long range plan drawn up has been stalemated for the past year by the unsettled domestic political situation.

And it is uncertain just how far the Government can go in long range planning, much as such action would help the Industry achieve a more stable condition. One company official points out that though more could be done by the Government in the area of long range planning, and though there is no lack of willingness on the Government's part, "the financial set-up in the Government is such that long range commitments, which would be beneficial to Canadian production, cannot always be made."

Non-Pessimism

BUT THERE is still no answer for the question uppermost in all minds: What does the future hold for Canada's Aircraft Industry? To this question there is no absolute answer.

In general, the Industry's mood is one of, if not optimism, at least non-pessimism.

The president of a leading Industry firm sizes up the situation in this cheerful fashion: "I feel very enthusiastic about the future, even if we have temporary setbacks. What we experienced during the last ten years cannot be considered entirely normal and readjustments are unavoidable in a free economy."

CANADAIR LINER.....

The new holder of the "biggest aircraft ever built in Canada" title—the CL-44—is, like its predecessor the CL-28 Argus, a Canadair product.

The CL-44 is now in full production for the RCAF, to which it is known as the CC-106, a versatile military transport with a maximum take-off weight of some 205,000 lbs.

Commercial versions are also being offered to the world's airlines in passenger, cargo, and combination cargo/passenger variants, for deliveries beginning in 1960. Deliveries of the RCAF's CC-106 are to begin towards the end of 1959. No announcement has been made of the number of CC-106's ordered by the Air Force, except to the effect that it was about enough to equip one transport squadron. A figure of eight has been mentioned unofficially.

Original plans called for the CL-44 to be powered by the Bristol Orion "supercharged" turboprop. However, this scheme has had to be scrapped as a result of Bristol's action in terminating the Orion project because of the withdrawal of support by the British Government. The RCAF order for Orions for the CL-44 was the only firm one on Bristol's books.

As a replacement for the Orion in the CL-44, the Rolls-Royce Tyne has been chosen. This would be the Stage 2 version of the engine, which is rated at some 5,330 ehp for take-off. It is understood that the Tyne will provide the CL-44 with slightly improved performance in most categories, except top speed, which will be a little lower than it would have been with the Orion.

With the new "thrift" class seating, the CL-44 (the commercial passenger version is known as the Canadair Liner, the cargo model as the Canadair Freighter) will be able to seat 154 passengers.

Fitted for tourist class, it can seat 123, and in one typical variant of combined accommodation, it can seat 16 first class passengers and 116 thrift class.

Maximum cargo payload is 68,200 lbs. (some of the weight figures may

be altered slightly as a result of the re-engining of the airplane).

Canadair says that the design is such that the aircraft can be converted from passenger to cargo use, or from one class of passenger accommodation to another, in four hours. Seats not in use can be stowed in compartments below the floor.

The CL-44 program is making use of much of the same tooling as the CL-28 Argus. A rough comparison of the two airplanes shows that the new transport is 38 per cent heavier in maximum gross weight, has a fuselage that is 20 per cent longer, is 25 per cent greater in range, and 100 per cent faster in cruising speed.

As a freighter, the CL-44 will carry a load of 70,000 lbs. across the Atlantic at a direct operating cost of between 4.5 and 5 cents a ton-mile, in contrast to the present cost of 10.5 cents a ton-mile.

As a thrift-class airliner, it can carry its 154 passengers non-stop from New York to London at a direct operating cost of 1.0 cent a seat-mile, including depreciation, compared with the present operating cost, in tourist class, of 1.8 cents including depreciation, or 1.4 cents excluding depreciation.

In the all-cargo and convertible versions, the Canadair Freighter has two loading doors with a maximum size of 6½ ft. by 10 ft., and a strong floor with tracks capable of supporting the heaviest cargo load. Special attention is being given to the problem of quick and easy loading, and various schemes of "palletized loading" will be available.

Auxiliary power units for the RCAF's CC-106's are being supplied by the Engine Division of Blackburn & General Aircraft Ltd. in the form of Artouste 510 gas turbines. These units provide shaft horsepower in addition to compressed air bleed, the former driving an alternator and the latter being employed for pneumatic starting of the main engines and for air conditioning. The whole unit can be installed in the aircraft as a self-contained power pod 74 inches long by 24 inches in diameter.



This the RCAF's version of the CL-44. Air Force designation is CL-66.

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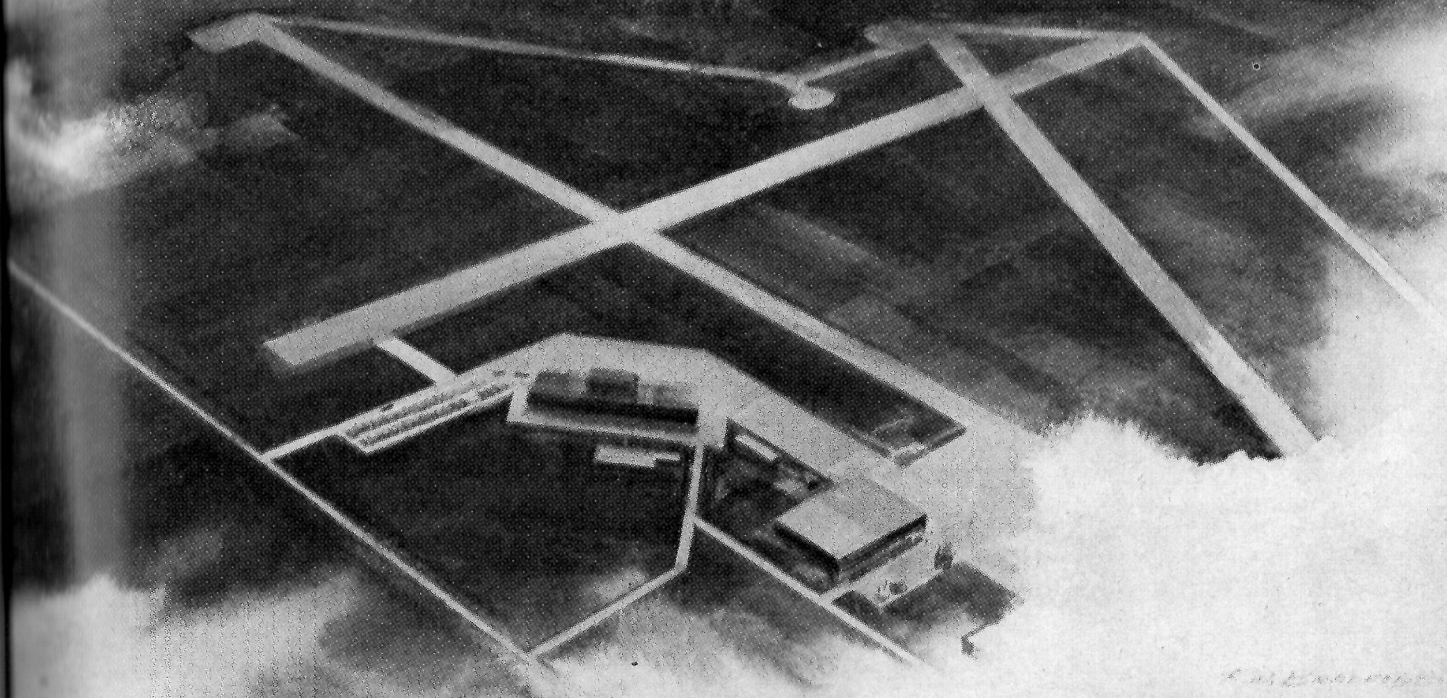
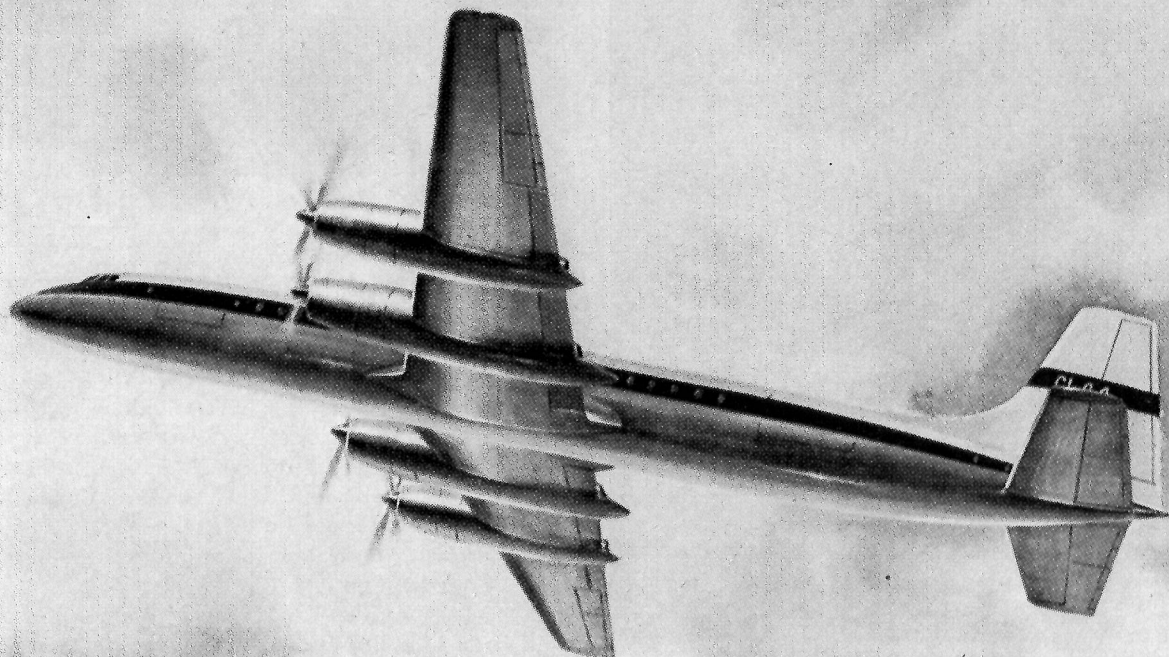
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DHC-2 BEAVER

THIS YEAR de Havilland Canada's DHC-2 Beaver celebrates its first decade of production deliveries. And on August 19, it will be an unbelievable 11 years since the prototype took to the air on its first flight. Almost from the moment that DHC designers first started to sketch out their ideas on paper, it became obvious that the company had conceived the proverbial "better mousetrap".

It was on April 26, 1948 that the first Beaver delivery was made, going to the Ontario Department of Lands & Forests. The original Beaver prototype, CF-FHB, was sold and delivered to Pacific Western Airlines (then B.C. Central Airways) in June of 1948.

From March, 1948, to December 31, 1957, there were 1,169 Beavers sold, including the L-20 military version for the U.S. Army. Of this total, 82% have been for the export market. Civil Beavers sold in the first decade number 409 (included in the total mentioned previously), and 48% of these have been for the export market. It is interesting to note that de Havilland Canada estimates the cash value of its export trade since World War II amounts to \$100,000,000, the bulk of which is accounted for by Beaver business.

It is de Havilland Canada's proud and unique boast that Beavers are serving in "58 countries and territories, on seven continents and at both poles." No other airplane, except possibly the DC-3, can make that claim.

DHC-3 OTTER

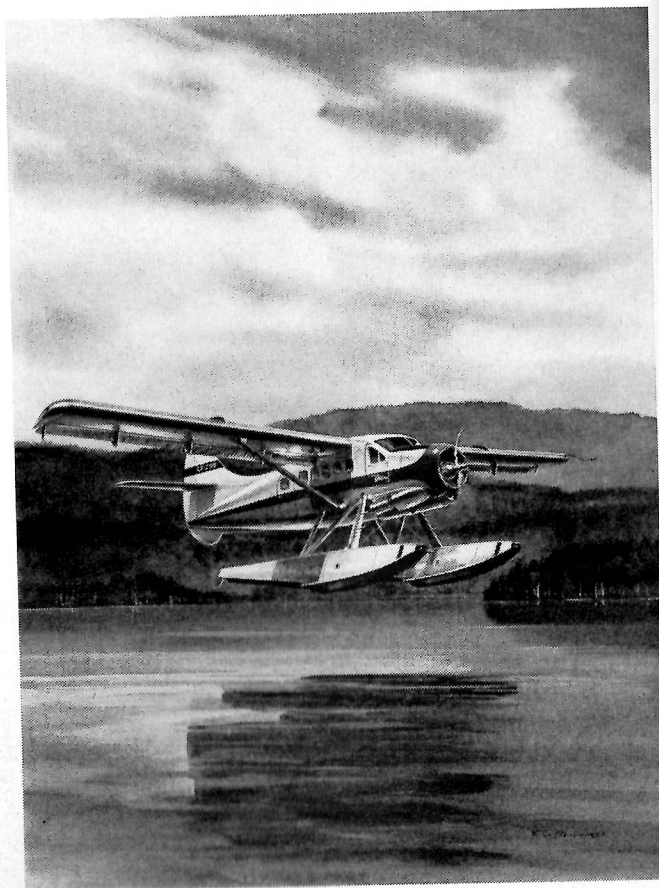
ANOTHER strikingly successful postwar project of the de Havilland Canada organization has been the DHC-3 Otter, which was designed to combine Beaver performance with a greater payload and longer range.

Since the prototype Otter first took off from Downsview Airport on December 12, 1951, the aircraft has found a ready market both in Canada and abroad as passenger carrier, freighter and military liaison and utility aircraft.

Although the development of the Otter was supported by the Canadian Government on behalf of the RCAF, the first delivery, on March 12, 1952, was to a civil operator, Wardair Ltd. of Yellowknife, N.W.T. It was not until December 5 of the same year that the first military Otter was delivered. It went to the RCAF, which has since taken 38 others.

Biggest single customer has been the U.S. Army, which in 1955 ordered 95. In the U.S. service, the Otter is known as the U1-A. Another large military customer is the Indian Air Force, which took delivery of the first of 26 Otters last October. Deliveries on this are slated to run through until July of this year.

In all, a total of 219 military and civil Otters had sallied forth by the end of last year and are now flying in civil and military service in 20 different countries. Of this total, 82 are civil and 137 are military. Some 55% of the civil models have been exported, and 68% of the military.





CANADAIR SABRE

ON AUGUST 9, 1950, just one year after Canadair signed a contract to produce 100 F-86 Sabres for the RCAF, Al Lilly, then Canadair chief test pilot, took the first aircraft of the order into the air on its maiden flight.

This was an F-86A and was the first of six marks to be produced for the RCAF and several other foreign air forces (only one Sabre 1 was built). Since that day nearly eight years ago, the original contract was boosted many times, and though the last Sabre for the RCAF was delivered in the middle of 1957, production still goes on for the West German Air Force. The West German contract calls for the fast aircraft to be delivered within 12 months of the start of deliveries in the fall of 1957. About half of the German order has now been completed. Thus, Canadair Sabre production will probably come to an end in the fall of this year.

A quick calculation indicates that when the last German Sabre is delivered, Canadair will have produced some 1,815 of the type in a number of variants, mainly 2's, 4's, 5's and 6's.

The Sabre has been a very profitable export item for Canadair, about 325 having been sold abroad on straight commercial deals. These export orders, besides those for West Germany, include 60 to the U.S., 34 to South Africa, and 6 to Colombia. As a result of Canadian Mutual Aid contributions, Canadair Sabres are also in service in several other foreign air forces additional to those already mentioned.

CANADAIR T-33

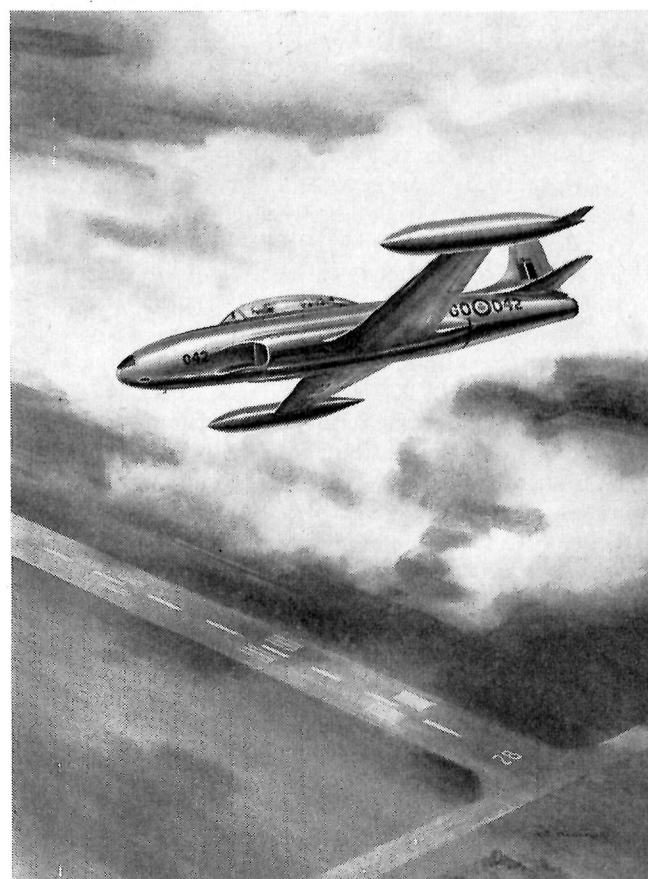
THE T-33 Silver Star continues in production at Canadair, but at a rate so low it is almost an exaggeration even to describe it as a trickle. Current plans call for T-33 production to terminate later this year, by which time over 600 will have been built.

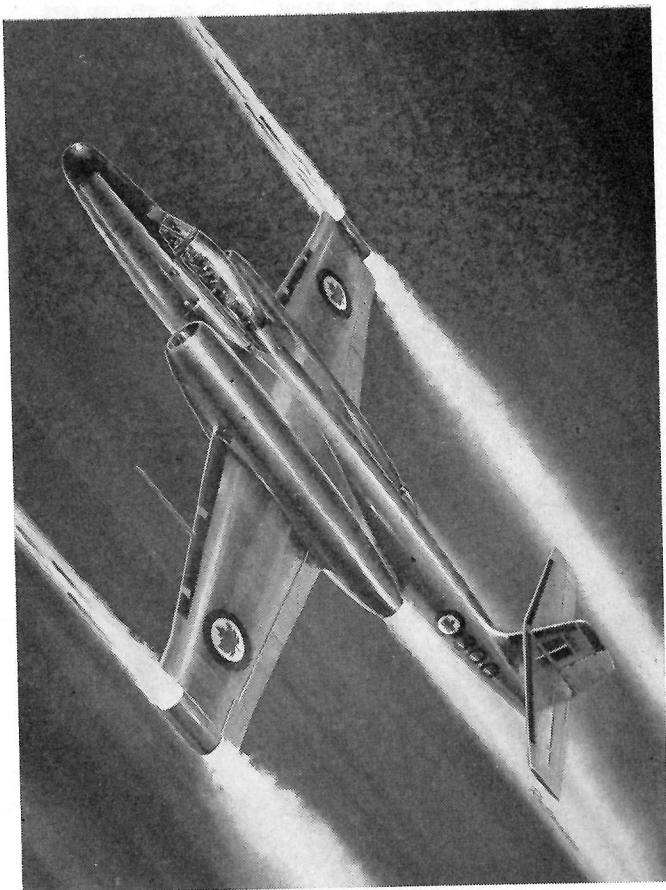
Most of these have gone to the RCAF, but a number have found their way into such foreign air forces as those of Turkey and Greece, via the Mutual Aid route.

The Canadian Government initially ordered 576 Silver Stars from Canadair in September, 1951, and the prototype aircraft took to the air in October of the following year. This aircraft may be described as a prototype, because though the Silver Star was basically the Lockheed T-33A, it was a variant in that it had been re-engined with the Rolls-Royce Nene. As a result of this modification, the Silver Star has markedly superior performance to the original Allison powered versions built in the U.S. by the T-33's designers, Lockheed Aircraft Corp.

Although Canadair was able to meet all delivery commitments for the T-33, considerable difficulty was encountered in the early stages. Most of this was caused as a result of one of the major sub-contractors, Ford of Canada, being unable to fulfil its contract for complete wing sets as a result of labor difficulties.

Principal role of the T-33 Silver Star in RCAF service, as elsewhere, has been as a pilot trainer.





AVRO CF-100

THE AVRO Aircraft CF-100 broke into the aviation export market last year with a \$43,000,000 order for the Belgian Air Force for 53 Mk. 5's. Deliveries were started within a few months of the receipt of the order, with 15 aircraft having been ferried to Belgium by the end of 1957. The entire 43 aircraft are to be delivered by the end of this year.

Although the CF-100 was selected by the Belgians from among a number of contemporary types which were vying for the order, the bill is actually being footed by the U.S. (75%) and Canadian (25%) governments. Canada's share, which is going down in the books as a Mutual Aid contribution, covers the supply of initial spares for the aircraft, spare engines, ground support and test equipment, training equipment, and conversion training for pilots for the operation of the aircraft.

This Belgian order, plus an extension of the Canadian order for Mk. 5's for the RCAF largely nullified the effects at Avro Aircraft of the cancellation of the Mk. 6 contract. It will be recalled that the Mk. 6 was the version being developed as a guided missile carrier.

Production figures for the CF-100 are classified, but are understood to be something in the order of 500 to date, this figure being made up mainly of Mk. 4's and Mk. 5's. The Mk. 5 differs from earlier versions principally in that its wingtips and tailplane were extended and the gun pack eliminated.

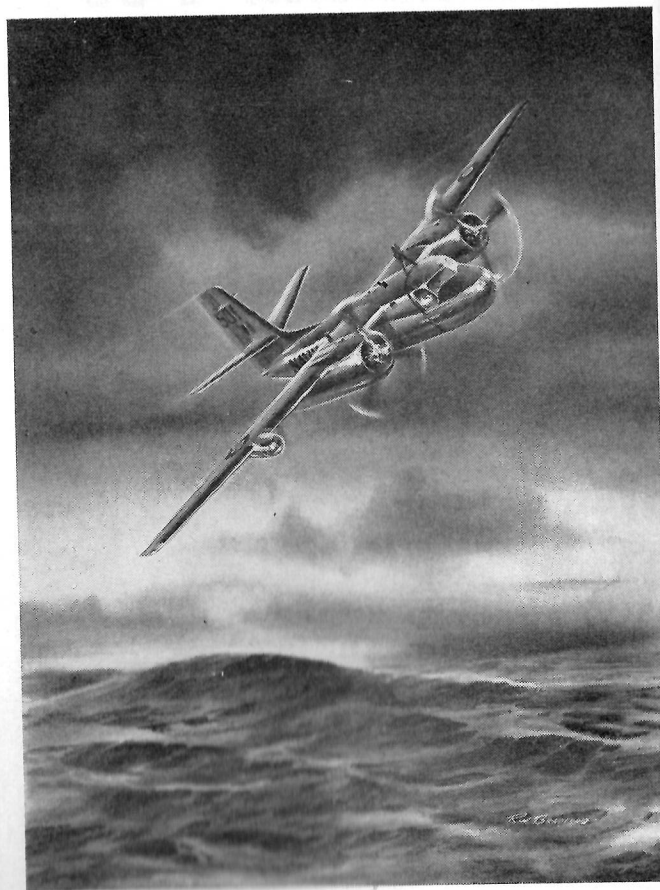
CS2F-1 TRACKER

DELIVERIES by de Havilland Canada of the license-built CS2F-1 Tracker anti-submarine aircraft it is building for the RCN are now well into their second year. The first Trackers were turned over to the Navy in October of 1956, having been delayed slightly by a strike which shut de Havilland Canada down for several months during 1955.

Production of the Tracker built up rapidly in 1957 and orders presently on hand will maintain production through 1959. The Navy's original order was reportedly for 100 aircraft. That Canada would contribute a quantity of Trackers to Mutual Aid for distribution to NATO naval forces, has been frequently mentioned unofficially, but to date no firm action has been taken in this direction.

A radar-carrying airborne early warning variant known as the WF-2 Tracer has been developed by Grumman for the USN, as well as a passenger/cargo version called the TF-1 Trader. There is a strong possibility that the RCN may order a few of the WF-2 Tracers built at the de Havilland, as it has a requirement for such an aircraft, currently being filled by Grumman AEW Avengers (Guppies).

A large part of the CS2F program is sub-contracted, with de Havilland Canada actually building the forward fuselage and pilot compartment, and as prime contractor being responsible for final assembly and installation of all equipment, as well as flight testing.



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CANADAIR CL-66

CANADAIR's newest project is the CL-66 Cosmopolitan, ten of which have already been ordered by the RCAF. The Cosmopolitan is, in fact, the well-proven Convair 440 Liner powered by Napier Eland turboprop engines.

The piston-powered version of the 440 is now being phased out by Canadair's American associate company, Convair Division of General Dynamics Corp., and tooling is being turned over to Canadair.

The idea of powering the Convair Liner with Elands originated with the engine's developers, D. Napier & Son Ltd., as a scheme to promote sales of the engine. As a private venture, Napier bought a Convair 340 and installed Elands. This combination resulted in striking improvements in just about every phase of performance.

The Cosmopolitan is an aircraft that has a sales potential far beyond the initial ten ordered by the RCAF. It is, for instance, a formidable contender for the Viscount and the new Lockheed Electra. It has a slight edge over the latter in that it has an airframe already proven in airline service.

The Cosmopolitan has a gross weight of 53,200 lbs., a cruising speed of 326 mph, a passenger capacity of 44 to 60 passengers or 10-15,000 lbs. of cargo, and a maximum range of 1,700 miles.

The Eland 6, the version chosen for the Cosmopolitan, is rated at 3,350 ehp.

CANADAIR ARGUS

WITH CANADAIR'S record for on-time deliveries, it seems almost superficial to say that the CL-28/CP-107 Argus program is forging ahead on schedule.

The official christening and handing-over ceremony of the first aircraft took place last Sept. 30, at which time there were three finished aircraft flying. One aircraft has been spending the winter flying out of Edmonton, undergoing its cold weather testing at the RCAF's Climatic Detachment.

All of the first six aircraft are assigned to various phases of the test program, which is expected to be completed in all aspects in a few months. First deliveries to Maritime Air Command for service are to begin in April, with aircraft No. 7 and subsequent.

The Argus is probably the most formidable maritime reconnaissance aircraft flying today. It can carry a complete offensive armament load of approximately 8,000 lbs. to a patrol area greater than 750 nautical miles from base, then search an area of 50,000 sq. nautical miles and return to base with an additional 500 nautical miles diversion allowance. This can be done with the aircraft carrying full armament throughout the operation.

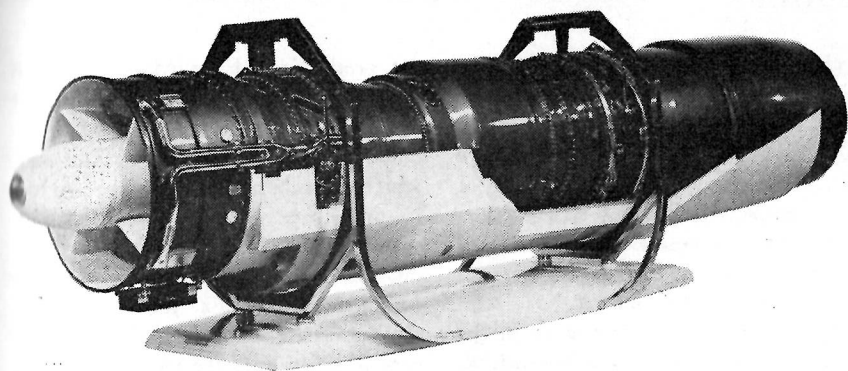
Detection equipment carried can detect, localize and shadow either submerged submarines or surface vessels. Submerged submarines are attacked with depth charges and torpedoes which can kill to depths exceeding 700 feet.



Photos show the original Convair 340 Liner which was converted to Eland turboprop power by Napier. Canadair CL-66 Cosmopolitan will be almost identical in appearance, but will be basically the later Convair 440 airframe.



Canadian Built Aero Engines.....



◀ IROQUOIS

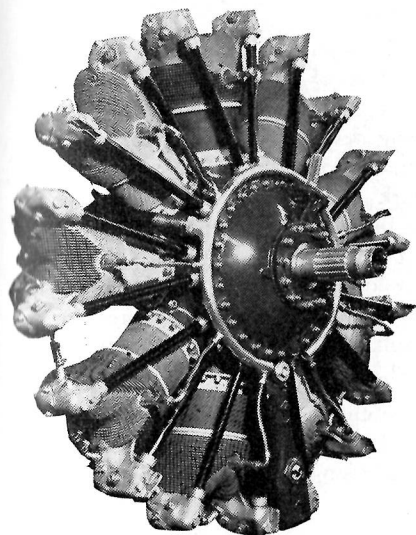
DEVELOPMENT of Orenda Engines' mighty Iroquois supersonic turbojet engine continues apace, with flight trials going ahead with the aid of a modified B-47.

The Iroquois is slated to power the CF-105 Arrow 2, which would indicate that the development program must be making satisfactory progress, as only the first handful of Arrows are to be of the Mk. 1 variety.

The engine, which has an integral afterburner, is currently producing over 20,000 lbs. thrust without recourse to the afterburner.

The most impressive evidence of the high regard with which the Iroquois design is held in the jet engine field, came when Curtiss-Wright signed a seven-year agreement with Orenda giving the U.S. firm the rights to manufacture, sell and further develop the Iroquois in the U.S.

Preliminary design of the engine was completed in December, 1953, and the first engine ran in November, 1954. Orenda Engines initiated the project as a private venture.



◀ WASP

THE PRATT & Whitney R-1340 Wasp continues in production at the Jacques Cartier plant of Canadian Pratt & Whitney Aircraft Co. Ltd., though at a very low rate.

Production of the engine in Canada began several years ago, with the first engine being completed late in 1952. The R-1340 was originally ordered to power the large number of Harvards which were being built by Can-Car.

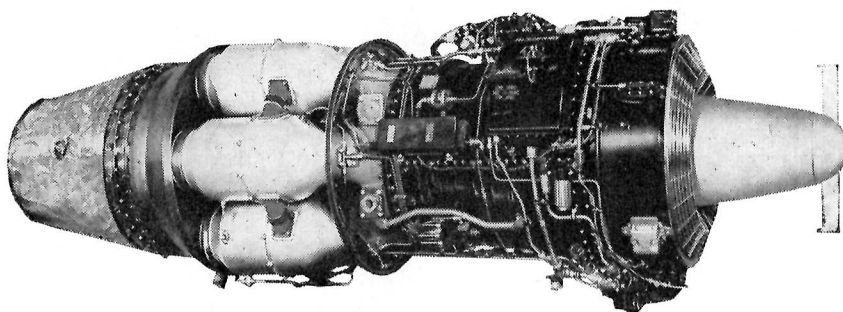
Production for this market has long been completed and current output is directed to the export market.

ORENDA ▶

PRODUCTION of the proven Orenda turbojet now exceeds 3,500 units and is into its sixth year. With the end of Sabre production in sight, and CF-100 production stretched to the extreme limit, it would appear that the market for this fine engine will soon dwindle to the vanishing point.

The Orenda will probably be phased out about the time its powerful successor, the Iroquois, is cleared for production. However, with several thousand Orendas in service all over the world, the demand for spares will continue to be high for many years to come, and thus a profitable source of income for the manufacturer. Though complete Orendas may disappear from the company's shops as production items, parts and complete components will remain a familiar sight.

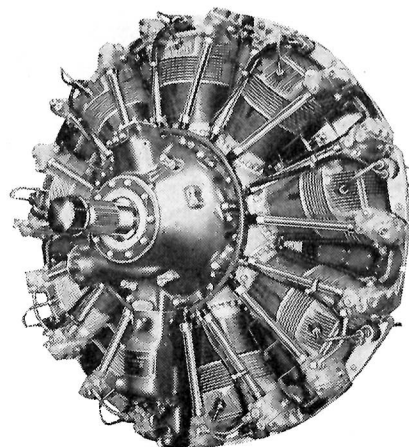
The models in current production are the Orenda 14 and Orenda 11.



CYCLONE ▶

UNDER license, Canadian Pratt & Whitney has for the past three years been producing Wright R-1820 Cyclones for installation in the Canadian-built CS2F-1 Tracker. The Cyclone program, which was estimated as being worth \$20,000,000 when it was first announced several years ago, still has about two years to run.

Though the Canadian-built Cyclone has been so far produced primarily for the CS2F-1, the type is also used in such helicopters as the S-58, H-34, and H-21A & B.



..... A Cross Section View of

Avro Aircraft

AVRO AIRCRAFT Limited is one of the Canadian Aircraft Industry's largest employers, with approximately 9,600 employees engaged on research, design, development and production. The Avro CF-105 Arrow, the company's current major project, has succeeded the CF-100 as the item that is taking most of the Engineering Division's time. The supersonic delta-wing interceptor is considered to be one of the most advanced fighters of this era.

Steady expansion has marked Avro's progress in the past year as the total personnel figure climbed by 800, and an increase in work area of some 31,500 sq. ft. boosted the Avro giant's working floor space to 1,700,000 sq. ft. for administration, engineering,

production, servicing, overhaul and repair facilities.

Avro Aircraft's major achievements, since being established in 1945, have been the design and development of three completely different types of aircraft. First, a commercial jet-powered airliner, known as the Avro Jetliner. Second, the CF-100 all-weather interceptor for the RCAF and with it, development of various systems such as armament (gun, rocket, guided missiles) and electronics. Third, the supersonic Avro Arrow which was unveiled to the public on Oct 4, 1957.

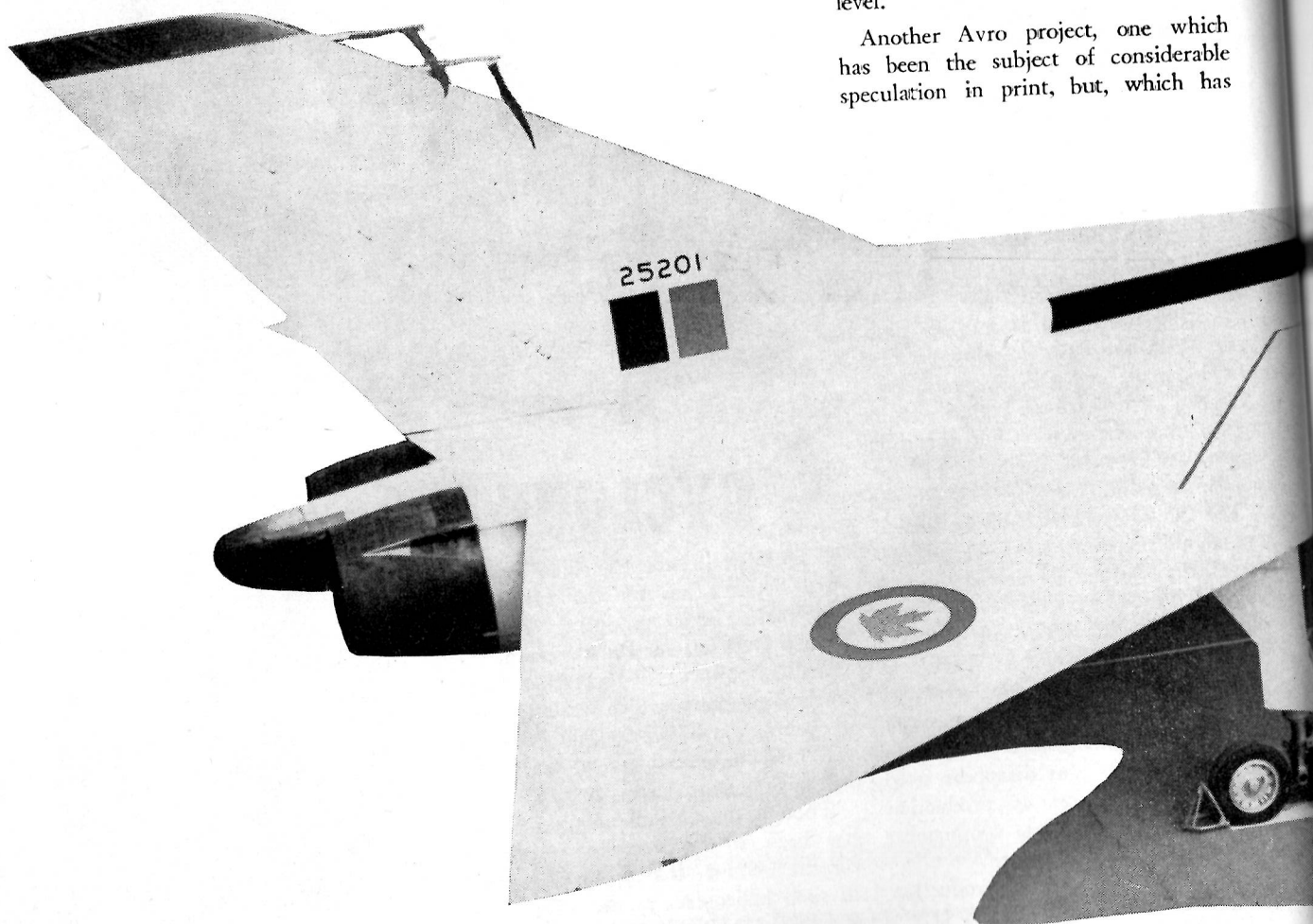
An important event of 1957 for Avro, was the Belgian government's selection of the CF-100 for its Air Force to meet a vital requirement for all-weather fighters.

Pending further development contracts and a government decision on long-term production for the Arrow, the company is continuing stretched-

out production of the Mark 5 version of the CF-100 for the RCAF. Present DDP contracts for the Arrow are reputed to call for 32-40 aircraft, which number includes five Arrow 1's and three Arrow 2's for test purposes. It is notable that these pre-production aircraft are being built by complete production tooling, a fact that assures a quick transition to volume production of the big fighter when government sources hand down the go signal.

Although the past year saw the cancellation of the Mark 6 CF-100 program, the continuation of the missile-firing development aspects of that program coupled with additional orders of Mark 5's for the RCAF minimized the impact of this cancellation. This fact plus the continuation of the Arrow development program, and Belgian order, allowed the company to maintain business at a satisfactory level.

Another Avro project, one which has been the subject of considerable speculation in print, but, which has



of Canada's Aircraft Industry

never been publicized by Avro is research into the VTO field. This program is sponsored by the USAF's Research & Development Command.

Canadair

AFTER SEVEN years of production, Canadair's bread-and-butter Sabre assembly line is scheduled to close down in October of this year. In that time, some 1,800 Sabre 2's, 4's, 5's and 6's have been produced for the RCAF, and the air forces of other countries. Canadair-built Sabres flew with the USAF in Korea; and with the RAF in Europe and the U.K.; others are presently in use with the West German Air Force, the South African Air Force, the Colombian Air Force, and several NATO countries, including Turkey and Greece.

At the present time, Canadair is the largest employer in Canada's Aircraft Industry with some 10,377 employees. A subsidiary of General Dynamics Corp., Canadair makes its home at Montreal's Cartierville Airport in a sprawling plant boasting some 3,177,692 sq. ft. of work area. In the past

year, the company has added 600 employees and 37,400 sq. ft. of floor space.

Although the greater proportion (72%) of Canadair's manufacturing contracts are of the government military variety, the company is growing increasingly active in the civil market. New projects along this line include the CL-66 Cosmopolitan, a twin-engine turboprop version of the Convair 440. Powered by Napier-Eland turbines, this aircraft, which is scheduled to go into production next year, will be offered for airline sale. Initially, the government has ordered ten of these Cosmopolitans for the RCAF's Transport Command.

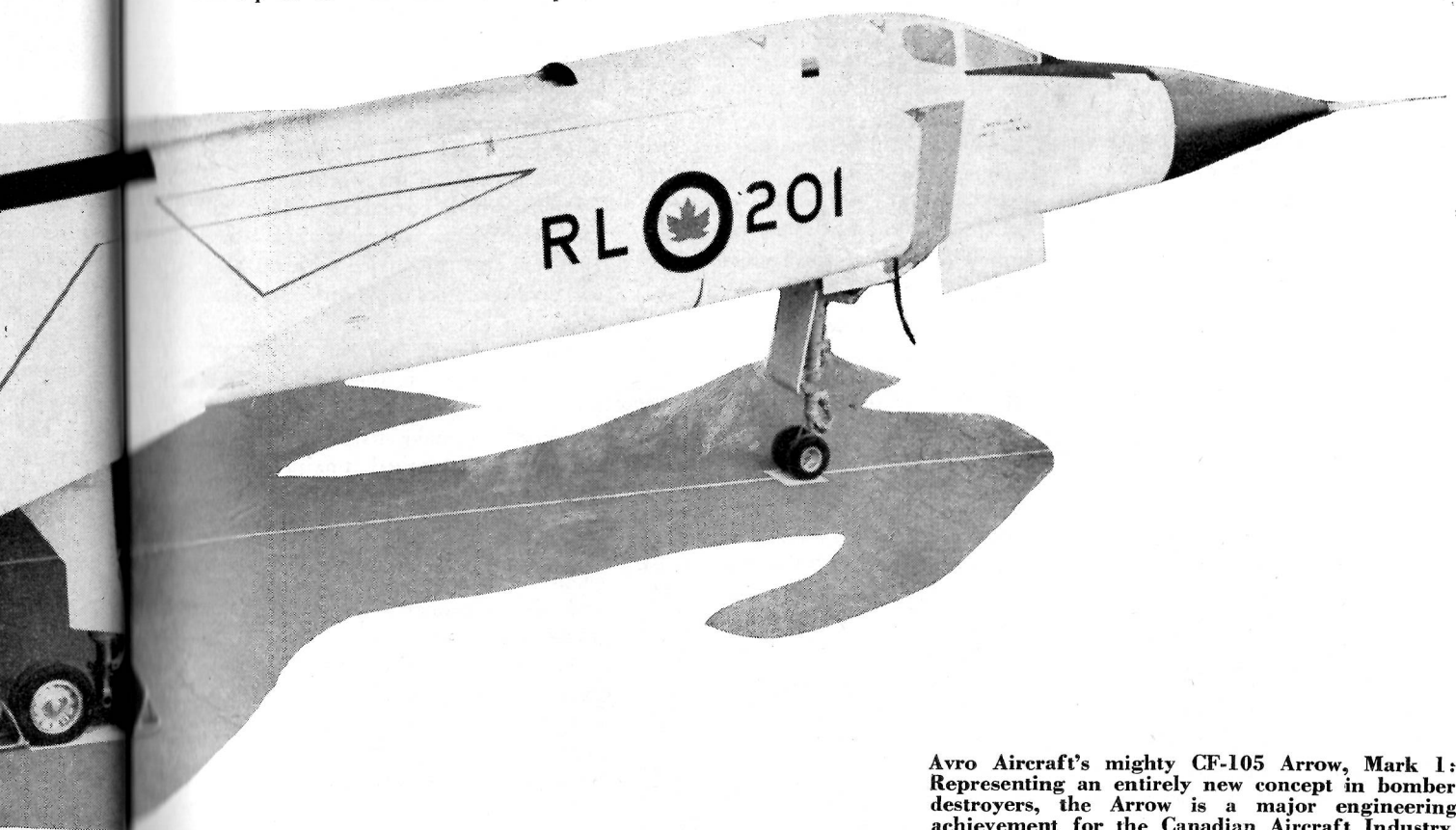
Another type of hardware for the RCAF's call-and-haul department is the CL-44, a turbine-powered version of the Bristol Britannia to be built by Canadair with first delivery slated for 1960. The company is currently conducting an aggressive promotion campaign to sell this aircraft on the world civil airline market. Present plans call

for both a passenger (123 to 154 persons) airliner, and a freighter (35-ton payload) version of the CL-44.

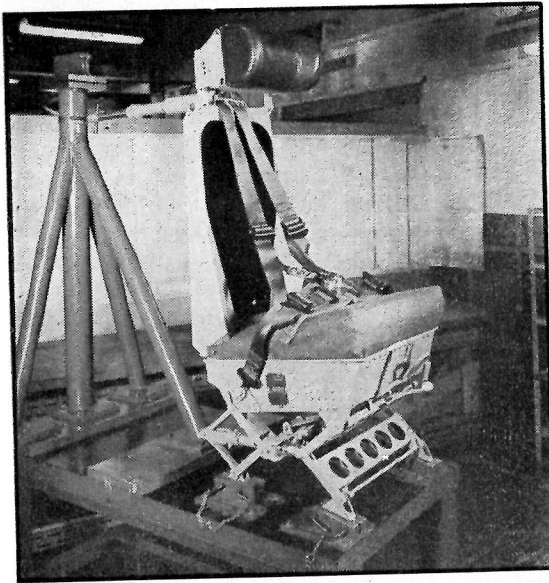
At the moment, Canadair's production facilities are chiefly engaged in turning out the CL-28 Argus maritime reconnaissance patrol aircraft. Around 50 of these big airplanes have been ordered for the RCAF's Maritime Air Command.

Other projects at Canadair include two prototypes of the CL-41 jet trainer, being built at company expense. These aircraft should be flying by next year. T-33 production for the RCAF has slowed down, indications being that no further orders will be received for the versatile trainer when present contracts expire this summer. The CL-41 Rat, a light tracked triphibious vehicle for duty in Canada's North — or similarly rough terrain — is being built.

Some nuclear and missile research and development is carried on at Cana-



Avro Aircraft's mighty CF-105 Arrow, Mark 1: Representing an entirely new concept in bomber destroyers, the Arrow is a major engineering achievement for the Canadian Aircraft Industry.



This is a crew seat made by Thor Industries Ltd. under subcontract to de Havilland Canada, for use in the Tracker.

dair, and the company is expected to play a large part in the production of the Sparrow 2 air-to-air guided missile.

Canadian P & W

LOCATED across the St. Lawrence river from Montreal, the Canadian Pratt & Whitney Aircraft Co. Ltd., sells, services and overhauls in Canada the products of United Aircraft Corp., its parent firm. Canadian P & W has expanded its facilities in the past year, increasing plant area by 95,000 sq. ft. to 846,000 sq. ft. The work force has remained more or less steady at 2,376.

Business with the Canadian government declined sharply during the year, with prospects of a further decline in 1958. On the other hand, Canadian P & W's export business increased last year by a greater amount than the loss represented by declining Government business, and company officials feel that a further increase is in the offing.

The civil market accounts for an unusually high proportion (65%) of Canadian P & W's business volume.

The company last May commenced installation of machinery and equipment in six major new departments devoted almost exclusively to the export business. These departments, all of a relatively high production nature, did not all reach full production until about the end of the year.

Canadian P & W sells Hamilton Standard propellers in Canada, as well as Sikorsky helicopters, and the aircraft accessories manufactured by Pesco Products Division of the Borg-Warner Corp. Although production of the

Pratt & Whitney Wasp R-1340 has been virtually phased out by now, some five or six of them are still being produced each month for export and for helicopter applications.

The chief project in engine production at Canadian P & W is still the Wright R-1820 Cyclone, for installation in the de Havilland Canada-built CS2F-1 Tracker. In connection with this, the company is also responsible for providing the Hamilton Standard model 43D51 hydromatic dural three-bladed propeller. The Longueuil, Que., firm manufactures all the components with the exception of the blades which are shipped in from Hamilton Standard.

The overhaul of aero engines, helicopters, propellers and aircraft accessories continues to provide a substantial flow of business. This year it amounted to 15% of the company's volume.

Canadian Car

THE AUTOMOTIVE and Aircraft Div. of Canadian Car Co. Ltd., Fort William, Ont., devotes some 230,000 sq. ft. of plant space to aviation activity, equal to 38% of total area. Aviation accounts for 42% of the Division's total business volume, with 94% of its aviation activity being in manufacturing. The remaining 6% represents repair & overhaul work on Can-Car products. At the present time some 324 men are employed on aircraft work, as compared to 255 a year ago.

The main activity at Can-Car's Fort William plant for the past three years has been the production of CS2F-1

Tracker components under sub-contract to de Havilland Aircraft Canada. The centre section and outer panel wing components of the Tracker comprise about 40% of the weight and value of the airframe. They also constitute the largest and most complex part of the airframe made by any sub-contractor.

In addition to the Tracker work, de Havilland chose Can-Car to manufacture Otter aircraft wing panels and empennage components. Coupled with the above sub-contracts, Can-Car manufactures and overhauls Harvard aircraft and a considerable volume of Harvard spares. With this aircraft dispersed throughout the world, Can-Car does a considerable export business in parts and spares.

De Havilland Canada

THE DE HAVILLAND Aircraft of Canada Ltd. is one of the largest exporters of single-engine STOL utility aircraft in the world today.

Located on the northern fringe of Toronto, de Havilland Canada increased its plant area last year by some 50,000 sq. ft., to a total of 882,374 sq. ft. Although employment figures are down slightly from last year to 3,725, it is notable that the company's employment roster has not varied more than 10% in the past three years.

One of de Havilland Canada's chief breadwinners continues to be the Beaver. In production since 1948, some 1,169 civil and military versions are in use throughout the world.

Otters which have been rolling off the Downsview assembly line since 1951, are now in service with military and civil operators in 20 different countries.

The company's current major engineering project is the DHC-4 Caribou twin-engine utility transport, scheduled to make its first flight in mid-summer. Limited production of the Caribou is planned for 1959 and volume production for 1960. At the present time, the U.S. Army has ordered five of the aircraft for test purposes, and the Canadian Army one (the prototype).

Another important contract is that for the RCN's CS2F-1 Trackers, built in Canada under license to the Grumman Aircraft Engineering Corp. The twin-engine, anti-submarine patrol air-

(Turn to page 43)

craft will continue in production for at least another year.

De Havilland Canada, in its recent annual report, said that net profit for the year ended Sept. 30, 1957, dropped about 61% below that reported for the previous year. Said P. C. Garratt, vice president & general manager: "The period under review reflects the unsettled international situation, the credit situation in Canada, and as far as we are concerned, substantial expenditures on our new Caribou."

Repair and overhaul is performed on all types of aircraft built by the firm over the years. The engine division last year processed some 310 Orenda engines from F-86 and CF-100 aircraft for the RCAF. Some 73 piston engines were overhauled, as well as 54 propellers and constant speed units.

Orenda Engines

PRE-PRODUCTION development of the Iroquois 20,000-plus lb. thrust turbojet is the foremost project presently going on at the Malton, Ont., plant of Orenda Engines Ltd.

One of the high-lights of Orenda's year was the seven-year agreement made with the Curtiss-Wright Corp. of the U.S. The American firm is under licence to manufacture and sell the Iroquois engine in the U.S. One American proposal for the engine is as the power-package for the North American F-108 supersonic fighter.

Meanwhile, at the Orenda plant near Toronto, work continues on both Orenda 11 and Orenda 14 engines for the CF-100's Sabres in production for or in service with the RCAF, the SAAF, and the West German Air Force, as well as the airforces of other countries. A steady flow of repair and overhaul engines is moving through the plant the year around. Over 3,500 Orenda engines are presently in use in Canadian-built aircraft.

It is indicative of Orenda's dynamic growth that a full 46% of the company's efforts are devoted to research and development projects.

Plant expansion during the past year of 40,000 sq. ft. has increased total plant area to 1,250,000 sq. ft. Total employment is down to 5,100 personnel from last year's 5,400.

Rolls-Royce of Canada

ROLLS-ROYCE of Canada Ltd., is a wholly-owned subsidiary of Rolls-Royce Ltd., of Derby, England. The Montreal factory is equip-

ped for the manufacture and assembly of jet engines, full overhaul, testing and manufacture of spare parts.

The facilities of the company devoted to the aviation market include 90,000 sq. ft. (an increase of 27,000 sq. ft. in the last year) of manufacturing, office and store space, together with modern jet engine test beds.

The company's initial project revolved around the \$33 million order for 900 Nene engines for the RCAF's T-33 trainers, for which deliveries were completed in 1955. A stipulation of the contract was that Rolls-Royce would create the facility to manufacture a number of these engines in Canada. Supplementing the original order for Nene engines, Rolls-Royce was given a contract from the DDP for the manufacture of spare parts for the Nene and the overhaul of engines from the RCAF. Later, with the introduction of the McDonnell Banshee into service with the RCN, facilities for the overhaul of the Westinghouse J34 turbojet engine were established at the Montreal plant.

The purchase of the Vickers Viscount by North American operators created the requirement for the establishment of technical services, and the provision of spare parts for the Rolls-Royce Dart turboprop engines which power this aircraft. A \$1 million extension has recently been constructed for overhaul and repair of all marks of Dart. A similar type of service has been maintained for the RCAF and TCA users of North Star aircraft which are powered by Rolls-Royce Merlin piston engines.

Aircraft Industries

LOCATED AT the Municipal Airport at St. Johns, Que., Aircraft Industries of Canada Ltd. is one of the largest firms in Canada

specializing in the overhaul, conversion and modification of all types of aircraft up to 35,000 lbs. gross weight.

Facilities offered by the company include sheet metal fabrication, radio and electrical systems installations, fabric, woodwork, and hydraulic overhaul. Other activities in the shop area which is contained in the 135,000 sq. ft. (an increase of 32,000 sq. ft. in a year) of space include instrument overhaul, painting, sandblasting, magnaflux, cable swaging, heat treating and cadmium plating. Total employment is approximately 400.

The company is presently engaged in overhaul work for the RCAF on such aircraft as Dakotas, Cansos and Harvards, as well as conversions and overhauls on various types of civil aircraft for executive and commercial operators.

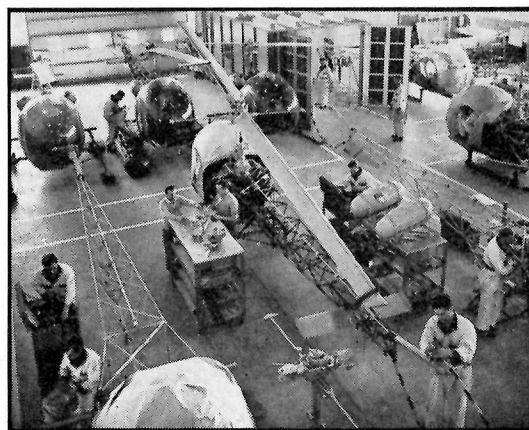
Bristol

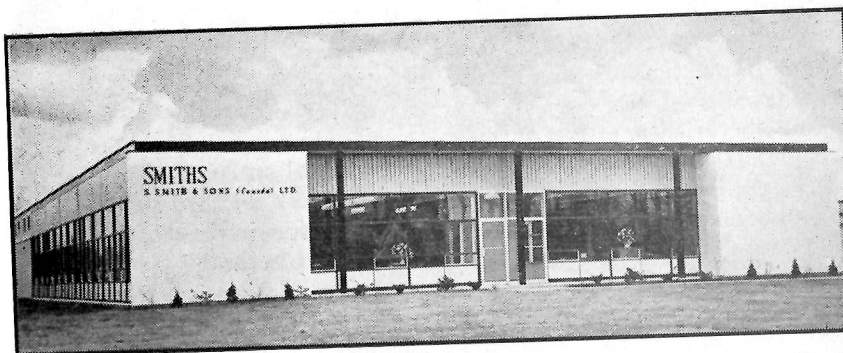
A WHOLLY-OWNED subsidiary of the British firm of the same name, The Bristol Aeroplane Co. of Canada Ltd., with headquarters in Montreal, controls four operating subsidiaries. Most recent of these to be added is Bristol De Mexico, S.A., which started operations in June 1957 as a piston engine overhaul centre for South America. The controlling company in Montreal is the sales executive branch of Bristol in Canada.

•**Bristol Aero Engines Ltd.:** This large (162,000 sq. ft.) and modern plant in North Montreal is equipped with the most up-to-date facilities available for the specialized processes, techniques and testing involved in the overhaul of engines.

Employing some 514, this plant handles the overhaul and reconditioning of Wright Turbo Compound engines for the RCAF C-119 and Neptune aircraft, and TCA Super Constellations. It also performs similar

Spartan Air Services operates this modern 14,000 sq. ft. helicopter overhaul & repair plant at Ottawa's Uplands Airport.

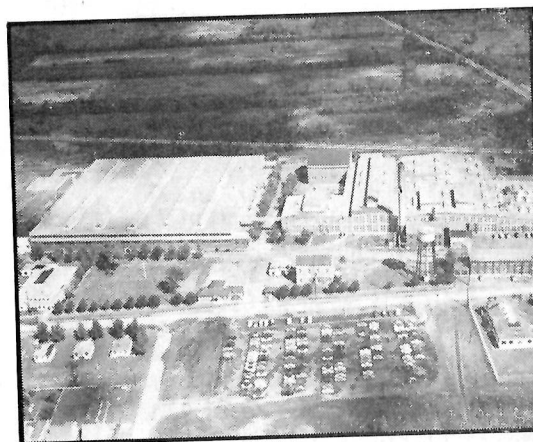




In Smiths new plant in suburban Toronto, the firm's Aviation Div. operates a modern instrument laboratory.



Above is Canadian Pratt & Whitney Aircraft's expanded manufacturing plant at Jacques Cartier, P.Q.



Canadian P & W's 1957 expansion included taking over all Sorel Industries plant facilities (below).

In this Toronto plant, Servomechanisms designs & produces precision computation and control systems.



work on RCAF Merlin engines for Lancaster and North Star aircraft.

The repair and overhaul of Wright 18-cylinder Turbo Compound engines for both RCAF and TCA represents the company's major undertaking at the present time, with the overhaul of Meteor tank engines for the Canadian Army as a departure from aircraft engine work.

•Bristol Aero Engines (Western)

Ltd.: Is the Vancouver counter-part to the Montreal plant. At its modernized plant at the International Airport, the company carries out the overhaul of Pratt & Whitney and Wright engines for the RCAF, and for several commercial airlines operating in western Canada.

The Vancouver subsidiary plays a major part in the repair and overhaul of the Proteus engines of CPA's Britannia fleet. In addition to the above-mentioned activities, the repair of propellers, carburetors and fuel injection systems is an important function.

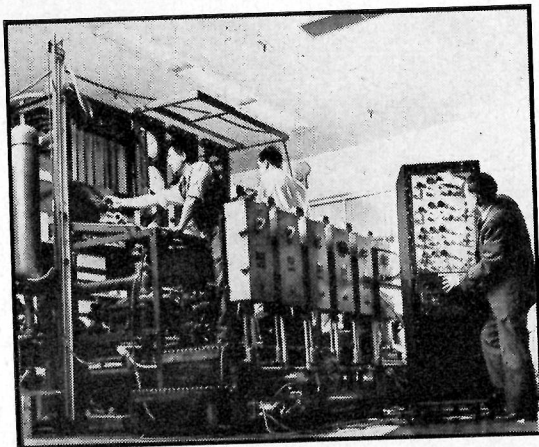
Rate of growth of the west coast company is evidenced by the increase in shop space by 12,000 sq. ft. to its present total of 68,000 sq. ft., and the employment figure of 132 which is a rise in the total figure of 114 a year ago.

•**Bristol Aircraft (Western) Ltd.:** Assumed the ownership of MacDonald Bros. Aircraft Ltd., of Winnipeg in 1954. The largest of Bristol interests in North America, this company occupies an area of 425,000 sq. ft., and is involved in a wide range of activities. These include the repair, overhaul and modification of RCAF Expeditor, Mitchell and CF-100 aircraft. Components for aircraft and jet engines are also manufactured at this plant, together with floats for land based and amphibious airplanes. The Winnipeg plant has a total of 1250 employees.

Aviation Electric

AVIATION Electric Ltd. has undergone steady expansion in the past year, both in personnel and work space. The Montreal firm has increased its work force from 729 to 839, and boosted its plant area from 115,000 sq. ft., to 150,000 sq. ft. Some 95% of its total manufacturing output is devoted to aviation products, mostly in the electronic field. The bulk of the company's activity is concerned with military contracts.

The stated purpose of Aviation Elec-



One of the Canadian Aircraft Industry's largest accessory manufacturers is Lucas Rotax. Photo shows fuel system test rig operated by the firm at its Scarborough, Ont., plant.

tric Ltd., is to sell, service and manufacture aviation products developed and marketed through the Bendix Aviation Corp., of which it is an affiliate. This includes the sales, service, repair and overhaul of aircraft instruments, accessories and ancillary equipment.

Aviation Electric runs a continuous program of research aimed at the design, development and manufacture of equipment required especially for Canadian aircraft and missile programs. The company's manufacturing operations are mainly devoted to instruments, fuel metering and hydraulic components.

Of interest is the 35,000 sq. ft. addition AEL made to its plant in the course of the past year. The new area houses an air-conditioned manufacturing machine shop and special test facilities for jet fuel controls, fuel flowmeters, and hydraulic and other equipment associated with highly inflammable liquids. The entire new section, which has been added to the existing plant in the form of a wing, has been equipped with air filtering, humidity and temperature control.

Canadian Applied Research

FORMERLY known as PSC Applied Research Ltd., this firm was acquired by the A. V. Roe Group in March 1957. One of Canada's leading designers and manufacturers of electro-mechanic instrument systems, CARL employs a staff of 400 and operates two plants in Toronto's east end with a total of 56,000 sq. ft. of space.

Current activities in the aviation field include engineering and production of R-Theta Navigation Computer Systems, automatic ice detection & shedding control systems, airborne profile recorders, armament intervalometers, microwave plumbing, auto-

matic tri-film processors, instrumentation and flight path positioning cameras, Gamble stereo plotters for aerial survey mapping.

CARL operates an environmental test laboratory service including an icing wind tunnel, and a complete technical publications service. Also, an RCAF-approved repair & overhaul facility is maintained.

Agency sales are handled in Canada for Kearfott Components and Systems, Robot Cameras, Transval Electronic Inverters and Power Supplies, and Sherman Fairchild Cameras.

CAE

CANADIAN Aviation Electronics Ltd., the Montreal company with the Horatio Alger story, is still moving ahead. With over 1,100 employees, it is one of the largest electronics firms in the country. CAE deals almost entirely with Department of Defence Production contracts, with the exception of its CPA contract for DC-6B simulators.

Of the large contract for 11 CF-100/4 flight and weapons system simulators, only a few remain in the large Montreal plant. More than half of the original order are presently in use with RCAF units, with others presently being installed at Air Defence Command bases. The RCAF recently ordered up a Mk.5 simulator which, it is expected, will ultimately be sent to the Belgian Air Force.

Other large RCAF orders for simulators include 12 general purpose trainers for twin-engine transport type flying; and a production contract for one CL-28 Argus flight trainer, as well as a design study of a CL-28 simulator complete with radar and weapons simulation.

CAE has two branch plants, one in Winnipeg and the other in Vancouver.

The Winnipeg operation has 240 employees working on the repair and overhaul of electronic equipment of the Pinetree Line. The smaller Vancouver plant employs some 56 technicians who are concerned with maintenance, repair and overhaul of radar units belonging to west coast RCAF units.

Canadian Steel Improvement

A MEMBER of the A. V. Roe Canada Group, Canadian Steel Improvement Ltd., has one of the most modern forge and foundry facilities in North America. Specifically designed to cater to the aircraft, aircraft engines, engineering and commercial industries, CSI has a roofed-in area of 180,000 sq. ft., and employs 450.

The expansion program completed last year by CSI was planned to offer new products such as large and medium sized aluminum forgings; large, medium and small titanium forgings; aluminum and magnesium sand castings; aluminum permanent mould castings; aluminum pressure die castings. Included are such service departments as a pattern shop; X-ray facilities; and large control and research laboratories.

The suburban Toronto company is divided into two divisions: the forging division, and the light metals casting division. In the first-mentioned is the light alloy forge, which is equipped with a battery of hammers of the Ceco-drop type, some of which are used for the precision forgings.

Furnaces of special design have been included in the layout for use in the manufacture of titanium forgings. Allied with these are the conditioning facilities, etching, anodizing and chromating baths. Found also in the forging division is the steel forge. This section, allied with the heavier equipment in the other forges, can produce turbine alloy, stainless steel and titanium die forgings to precision dimensions.

In the light metals casting division are the aluminum and magnesium sand foundries, the permanent mould and die cast foundry, the refinery and the ancillary shops.

Collins of Canada

IN AUGUST 1957, the Department of Defence Production awarded Collins Radio Co. of Canada Ltd. one of the largest contracts ever plac-

ed in Canada for a single item of airborne electronic equipment. This was a production contract valued at \$8,300,000 for UHF airborne transceivers, designated the AN/ARC-552.

The AN/ARC-552 is a 1750 channel UHF transceiver having a frequency range of 225 to 400 mc., and a transmitter output of 20 watts. It is the successor to the AN/ARC-27 radio still in use in RCAF and RCN aircraft. Though having the same number of channels and operating over the same frequency band, the new radio is only half the size of the ARC-27.

In addition to the above work, the Toronto-based subsidiary of Collins Radio Co., Cedar Rapids, Iowa, is working on another DDP contract for the AN/ARC-38 HF transceiver for the RCAF. This is a 35,000 channel, 100 watt transceiver operating from 2 to 25 mc. In addition, the associated type CU-351 antenna coupler is being produced.

Some 125 employees are kept busy in the 25,000 sq. ft. Toronto plant. An export item produced by Collins of Canada is the Collins 18S-4 HF transceiver, which is a 20 channel piece of equipment operating from 2 to 18.5 mc. Sales have been made to a variety of overseas airlines. Other civil commercial sales have been in Collins lightweight Com/Nav equipment, autopilots and integrated flight systems.

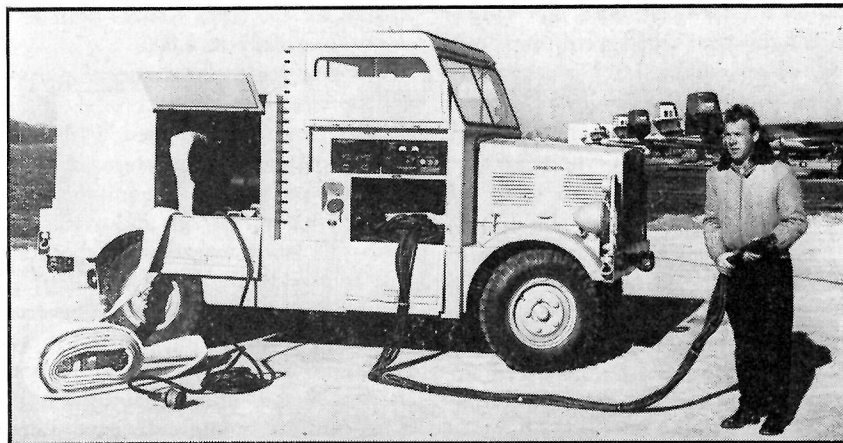
Computing Devices

CURRENT aviation activities of this Ottawa electronics firm include research & development, manufacturing, and repair & overhaul.

The Position & Homing Indicator is an automatic DR navigation system for single-seat military aircraft. The mark 3 version is fully transistorized and weighs less than 25 lbs. complete. The PHI was developed by CDC and is now in production.

The Antac is a long range DR navigation system coupled to an integrated tactical display developed and now being manufactured for the Argus. It has facility for external reference from a variety of electronic radio and radar inputs.

Currently being manufactured by CDC, though developed elsewhere, are the ASQ-8 Magnetic Anomaly Detector, and components of the Sparrow 2 missile. The company has a contract for the repair and overhaul of the ASQ-8, separate from the manufactur-



CF-105 ground support equipment is made by Consolidated Diesel Electric of Canada. Unit above is for electronics and fire control systems servicing.

ing activity.

Under development, and not yet in production, is the navigation system for the CF-105 Avro Arrow.

Application of a very large computer designed and built by CDC to air traffic control simulation is being studied for the U.S. Civil Aeronautics Administration. The computer was originally designed as a naval tactical trainer.

The Skyline Doppler Navigation Computer is under development as an advanced navigation system for commercial aircraft.

In agency sales, CDC handles most of the electronic equipment produced by the Bendix Aviation Corp.

Fairey of Canada

THIS DARTMOUTH, N.S., firm is currently engaged in modification and overhaul programs on RCN Banshees and Trackers, and RCAF Lancasters and Neptunes.

In addition to aircraft work, the company's Hydraulics Division is manufacturing and reconditioning Hydro-booster units for the CF-100. This division is also engaged in the manufacture of the Fairey Microfilter. Design studies are in hand for a Microfilter to handle flows of 300 gpm and for hydraulic and pneumatic components and electro-mechanical servo-mechanisms. Hydraulic actuators are also being produced by this division for the Canadair CL28 Argus together with hydro-pneumatic actuators for the nose landing gear of the CF-105.

Equipment procurement and personnel training is providing a facility to handle aircraft electrical and electronic equipment. Additional plant facilities include a sheet metal shop with

a 200-ton hydraulic press used for forming sheet metal parts. The 235,000 sq. ft. Dartmouth operation employs some 960.

Fairey's branch plant at Patricia Bay Airport, British Columbia, which occupies approximately 50,000 sq. ft., is currently overhauling, modifying and repairing civil and military aircraft. This program includes work on Avenger aircraft to convert them to crop dusting roles. Owing to its location, work for civil commercial operator's predominates at this Pacific coast plant.

Renfrew Aircraft

RENFREW Aircraft & Engineering Co. Ltd., located at Renfrew, Ont., is one of the larger manufacturers in Canada of combustion for gas turbine engines, having work facilities covering 107,000 sq. ft.

Among other activities of this firm is the design and manufacture of tooling and a variety of fueling equipment for airport uses. The company is equipped to undertake large scale production work of complete units, components or parts, sheet metal and machine tool work, as well as special engineering and development projects.

In addition to the equipment necessary for the above-mentioned operations, the RCAF-approved facilities include a fully-equipped metallurgical laboratory, extensive inspection and testing equipment, a Lindner Micro-Optical Jig Borer, hydroform presses and up-to-date induction brazing and welding equipment.

Jarry Hydraulics

EMPLOYING some 250 at its Montreal plant, Jarry Hydraulics has, in the past year, increased working space 18,000 sq. ft., to a

total of 75,000 sq. ft. Although activity in the aviation field comprises only 50% of operations, Jarry is one of the largest producers of hydraulic aircraft components in Canada. Military work comprises 80% of the firm's aviation business.

Chief activity at the present time is the fabrication of nose-wheel assembly for the CF-105 Arrow. The complete assembly comprises the bare strut, drag stay, and steering system. The strut is of steel fabricated by submerged arc welding and heat-treated to 180-200,000 psi. The drag stay is made up of two separate steel forgings and hydraulic locking is at 4,000 psi. The steering system was specially designed by Jarry Hydraulics to overcome space limitations in the aircraft.

Another component of the CF-105 made by Jarry is the hydraulic elevator actuator. The actuator cylinder is of the double-acting tandem type with balanced area, and operating on a hydraulic pressure of 4,000 psi. The maximum design output load is 72,000 lbs. A follow-up system of linkage ties in a servo valve in such a way that the jack can be operated either manually by the pilot, or by the auto pilot. The aileron and rudder jacks, of essentially the same design, are also designed and manufactured by Jarry.

Lucas-Rotax

LUCAS-ROTAX LTD. of Toronto devotes its entire 150,000 sq. ft. of working space to the design, manufacture, repair and overhaul of fuel systems for gas turbine engines and aircraft electrical systems. Current projects include the design and fabrication of the fuel system for the Orenda Iroquois, and the electrical

system for the Avro Arrow. Staff level continues steady at 1,000.

For research & development purposes, the electrical section of the Engineering Dept. is equipped with constant speed drives, radio screened room, winding and balancing equipment, together with refrigerator and oven. This facility is being extended by the addition of vibration equipment so that all phases of development can be covered.

The development of a 30 KVA aircraft generating system, together with its associated control and rectifier units, is in process as are associated safety relays and aircraft flasher units. Magnetic amplifier controls and separate rectifier units are also under active development.

The fuel laboratory is equipped with a compressed air supply with a capacity of 4,500 cfm, 300 psi continuously rated. This equipment has been installed in order that work on air turbine driven accessories such as fuel pumps, starters and other units, can be carried out. Effort at the moment is largely concentrated on the development of a system for a large jet engine.

Phoenix

PHOENIX Engineered Products Ltd., Toronto, undertakes the overhaul and repair of all types of aircraft instruments, including automatic pilots, gunsights, aerial cameras and electronic devices. Most of the total effort put out by the firm's 200 employees is devoted to work on instruments for the RCAF and RCN. Phoenix has 73,000 sq. ft. of floor space in its north Toronto plant.

The company also manufactures pressure transducers, position and attitude transducers, and other types of telemetering equipment. Manufactur-

ing and development work is done as well on fuel pumps and test equipment.

Phoenix sells aerial cameras and survey apparatus, as representatives for Avimo, Williamson Mfg. Co. Ltd., and N.V. Optische Industrie Old Delft.

Northwest Industries

LOCATED on Edmonton's Municipal Airport, Northwest Industries Ltd., has approximately 700 employees engaged in the various phases of its operations. The largest percentage of the company's work volume comes from its Military Aircraft Department. This department overhauls, repairs and converts RCAF C-119's, Harvards, and T-33 jet trainers.

The Commercial Aircraft Service Department has developed into an important phase of the company's operation, counting among its customers scheduled and charter aircraft operators, owners of business aircraft, and Federal government departments. The company is approved as a Douglas DC-3 and C-47 service centre.

The Instrument & Electronics Department, which was destroyed by fire in 1956, has been re-established in a new laboratory of steel and brick construction. The building is fully equipped with up-to-date repair and testing facilities, including environmental testing.

The instrument repair facilities have been approved since 1952 by the DoT and surveillance of the complete military program is exercised by a resident detachment of RCAF Quality Control Inspectors.

The Engineering Department of

(Continued on page 65)



One of Canada's most modern aircraft overhaul facilities is maintained at Edmonton by Northwest Industries Ltd.

Northwest Industries is engaged in developing and perfecting modifications and improvements to aircraft, design studies and new developments. The Publications Section of this department is largely staffed by trained people brought to Canada from the U.K. This section is actively engaged in the preparation of Engineering Orders on the Fairchild C-119 Packet for the RCAF.

Raytheon Canada

RADAR AND other electronic products are the chief concern of Raytheon Canada Ltd., a subsidiary of the Raytheon Mfg. Co., Waltham, Mass. The Waterloo, Ont., firm has a staff of approximately 100, and is engaged in the design, development and manufacture of long range ground and surveillance radar, indicators and displays.

Current major project for the Canadian plant is the filling of an \$8,000,000 contract for the development and production of 15 surveillance radar systems, known as Airport & Airways Surveillance Radar, for the DoT. This contract, awarded in 1956, calls for the installation of the 15 radar units at civil airfields across Canada by 1959. The equipment will give Canada practically continuous civil radar coverage for internal air traffic control.

Recently it was announced that the DoT intends to duplicate the Raytheon AASR equipment at each installation, to meet any emergency involving breakdown of power supply or equipment.

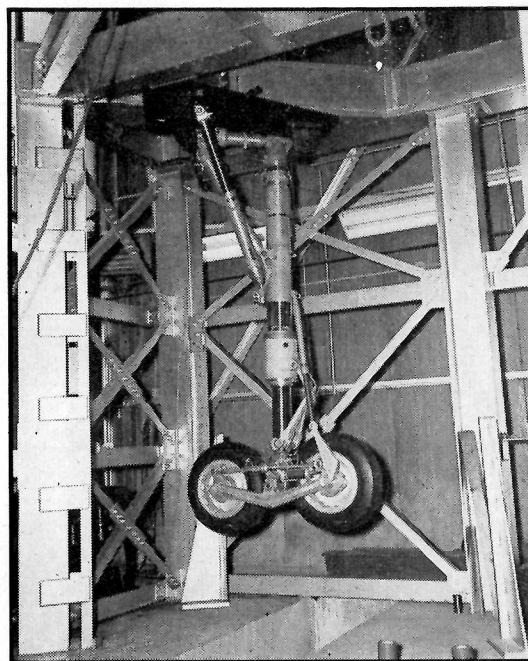
Sperry of Canada

SPERRY Gyroscope Co. of Canada Ltd. continues to design, develop and manufacture aeronautical equipment for the military and commercial requirements of Canada's air industry. The company's 75,000 sq. ft. plant is located at Montreal and employs 480. In addition to defence contracts in the past year, the company continued exports of equipment to NATO air forces and other foreign customers.

In the manufacturing field, large numbers of the Sperry Gyrosyn Compass, which is standard with the RCAF, RCN, TCA and CPA, are being produced.

New developments in the compass field include the Canadian designed Sperry LDG-1, Low Drift Gyro with a random drift rate of plus or minus 1° per hour. This high accuracy head-

This Dowty test rig is used to perform landing gear retraction, shock absorber closure, and fatigue tests on main gear for CF-105 Arrow.



ing reference is particularly suitable for polar navigation, and for use with the latest developments in precision navigation equipment. A logical further development of the LDG compass system is the Sperry-Canada Two Gyro Stable Platform, the prototype of which will be completed during 1958.

An associated development of the Gyrosyn Compass is the Roll Correction Computer, which provides by computation and correction an accurate compass heading at all times during varying aircraft attitudes of pitch and roll.

The Kollsman machmeter, airspeed indicator and altimeter continue to be manufactured for military use. A new development in this field is the Sperry-Canada Servo Altimeter which has completed laboratory tests and is scheduled for flight tests in the near future. This new instrument provides facilities for any desired type of presentation and more accurate performance than existing altimeters, as well as supplying a highly accurate source for air data information.

The Sperry A-4 Gun-Bomb Rocket Sight has continued in quantity production against military and overseas orders. Further development of a Sperry U.S. designed airborne radar was undertaken to meet specific Canadian needs and plans are well advanced to produce the equipment in Canada for a military requirement.

The new Sperry SU-30 Gyropilot has been specified by TCA for its DC-8 aircraft, and the Sperry SP-20 Gyro-

pilot by CPA and MCA on their DC-6 aircraft. A recent development in the flight control field has been the manufacture by Sperry-Canada, under sub-contract, of Missile Flight Control equipment.

Dowty of Canada

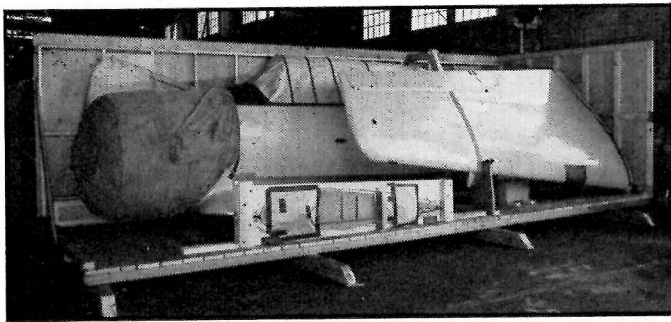
DOWTY EQUIPMENT of Canada Ltd., which has headquarters at Ajax, Ont., near Toronto, is a self-contained organization with a staff of some 350, and engaged in the design, development and manufacture of landing gear and hydraulic equipment mostly for military aircraft. The Ajax plant has a total of 60,000 sq. ft. of working space.

Current activity at Dowty involves the design and production of aircraft landing gear, electro-hydraulic and hydraulic equipment for the Avro Arrow, and CF-100, as well as for the de Havilland Caribou, CS2F Tracker, and Canadair Ltd.'s Argus and CL-44.

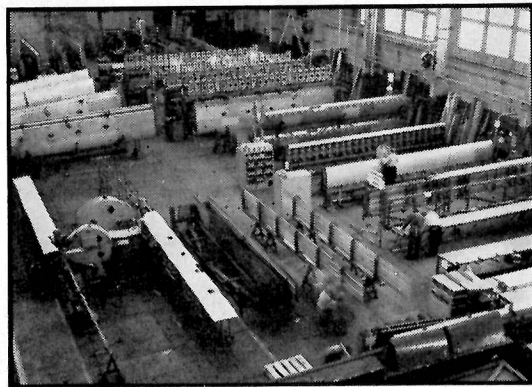
Under a licencing agreement with the Dunlop Canada Ltd., Dowty is involved in the manufacture, sales and service and repair of Dunlop wheels, brakes and related hydraulic and pneumatic equipment. The Canadian firm does repair and overhaul work as required for the RCAF and RCN.

Standard Aero Engine

LOCATED at Winnipeg's Stevenson field, Standard Aero Engine Ltd., provides a complete overhaul facility for aircraft engines (up to 1500 hp) and accessories. Engines currently being processed in the



Above, a Can-Car overhauled Harvard 2 being crated for overseas shipment. R. Otter wing panel assembly at Can-Car for DH Canada.



43,000 sq. ft. shop include Pratt & Whitney, Continental, Lycoming, Franklin, Jacobs and Gypsy. Standard's work-force is now 341 up about 20% in the past year.

The company handles a wide variety of accessories. Modern equipment is maintained to overhaul and test electrical accessories for engines and airframes, oil system equipment, wheels and brakes, hydraulic systems accessories, ice elimination and air systems components, and fuel systems equipment for both piston and gas turbine engines.

In addition to its overhaul facilities, Standard Aero is a distributor for products manufactured by Continental, Lycoming, Pratt & Whitney, Aircooled Motors, Jacobs, Bendix Products Div., AC Div. of General Motors, Packard Cable, McCauley, etc. sales and service branches are maintained both in Edmonton and Vancouver.

Honeywell Controls

HONEYWELL Controls Ltd., which employs altogether about 1,000 persons in Canada, specializes in the design, development and manufacture of automatic devices and instruments. The Aeronautical Division of the Toronto firm is doing a major share of the engineering development work on the Avro Arrow's complex electronics systems.

Typical development for the CF-105 is the Honeywell levelling and heading system. This equipment controls the gyro-stabilized platform which always points to a reference direction and therefore serves, in a sense, as a compass.

Honeywell also played a major role in the design and engineering of ground test equipment including that which has been used to test the Arrow's electronic damping system before the aircraft's first flight. This damping system detects and controls oscillation of the aircraft automatically. Other Honeywell equipment includes a Centre of Gravity Control system, which provides automatic sequential draining of fuel tanks thereby aiding the damping system to maintain stability at all times. Other items are the fuel gauge system, and the exhaust gas temperature indicator.

More recently, Honeywell Controls Ltd., were named as one of three Canadian sub-contractors for engineering services relating to an electronic weapon system under development by RCA and the Minneapolis-Honeywell Regulator Co., for the CF-105.

Enheat Aircraft

ENAMEL & Heating Products Ltd. of Amherst, N.S., with a plant area of 195,483 sq. ft., devoted to aviation activities and em-

ploying some 300 persons, deals exclusively with military aircraft spares and components production. Their operation includes also the repair and overhaul of parts and components; tool and jig making; and the sale of some parts and aircraft materials.

The company is presently engaged in manufacture under sub-contract to de Havilland Canada of the empennage and aft fuselage for the RCN's CS2F-1 Tracker aircraft. The contract calls for 99 sets, of which 51 have been delivered. Enheat's overhaul and maintenance program includes components of RCN Banshees and RCAF Neptunes. The manufacturing operations comprise about 75% of Enheat's efforts, with repair & overhaul accounting for the remaining 25%.

Field Aviation

ONE OF THE Hunting Group of companies, Field Aviation has its headquarters at the Municipal Airport, Oshawa, Ont., and another plant at Calgary. The Oshawa operation has a plant area of 76,000 sq. ft., and employs over 200. Field's total business volume is divided between four main activities: repair and overhaul of aircraft and components; manufacture of certain components; sales and service of Beech aircraft; and sales of parts and supplies.

Repair and overhaul facilities are maintained at both the Oshawa and Calgary plants. These services are utilized by commercial operators and by executive aircraft operators. Also included in this line of work, is the storage, inhibiting, and servicing operations conducted for the RCAF.

Manufacturing operations include work for Defence Production on ground handling equipment, special thermodynamic instrumentation work for Orenda Engines Ltd., and design and manufacture of air starting carts for jet aircraft.

The supplies and parts sales business is conducted from the Oshawa headquarters and from branch offices located at Ottawa, Winnipeg, Calgary and Vancouver.

RCA Victor

CHIEF ACTIVITY in the aeronautical line at RCA Victor Co. Ltd., Montreal, is in the role of a sub-contractor to Radio Corp. of America in connection with the research and development program springing from need for an electronic weapon

system for the CF-105.

RCA Victor's contribution to this program is in the nature of engineering studies and the provision of engineering services in connection with electronic portions of the CF-105 integrated weapon system.

Fleet Manufacturing

UNCERTAINTY presently clouds the future of Fleet Manufacturing Ltd., Fort Erie, Ont., an early member of Canada's aircraft industry which has had more than its share of ups and downs.

A recent attempt by the Fleet executive to sell the company's physical assets to de Havilland Canada, was defeated by a shareholders' committee. Following this, a new board was elected, headed by Air Vice Marshal A. Frank Lang as chairman.

Fleet's principal activity in recent years has been as a sub-contractor to aircraft firms in Canada and the U.S., mainly in the fields of sheet metal and plastics fabrication. It also obtained the Canadian rights to the Helio Courier, but the aircraft did not sell.

A similar experience followed when Fleet became associated with Doman Helicopters in a company known as Doman-Fleet Helicopters Ltd., the aim of which was to produce and sell the Doman LZ-5 helicopter in Canada (using Fleet Manufacturing's facilities). Unfortunately, the most important single potential customer, the Canadian Government, failed to buy. This and other similar projects which failed to work out profitably, lead to a series of financial losses \$91,225 in 1956, \$174,790 in 1957). In spite of these setbacks, the fact that the company currently has a \$2,500,000 backlog of orders would indicate that it has a good potential. There are about 400 employees.

Other Companies

•**Aeroquip (Canada) Ltd.:** Subsidiary of Aeroquip Corp., Jackson, Mich., this Canadian firm is located in suburban Toronto. Aeroquip (Canada) is engaged in design, development and marketing of flexible hose assemblies incorporating detachable and reusable fittings, self-sealing couplings, light weight elbows and rigid tubing, Marman clamps and tie-down equipment.

•**Aircraft Appliances & Equipment Ltd.:** Basically concerned with repair & overhaul of aircraft electrical and electronic equipment and accessories,

this Toronto firm also handles sales & service of such well-known lines as Jack & Heintz equipment, Hartman relays, and a variety of electronic equipment put out by Electronic Specialty Co., of Los Angeles. Employees number 50, up 15 in the last year; plant area is 17,000 sq. ft., an increase of 3,000 sq. ft. since 1957.

•**Aircraft Overhaul & Repairs Ltd.:** This long-established firm operates a 15,000 sq. ft. plant at Lac a la Tortue Airport, near Grand Mere, Que., where it specializes in repair & overhaul work for civil operators, on aero engines up to 600 hp and aircraft of up to 20,000 lbs. With land, ski, and water landing facilities available, a considerable number of seasonal changeovers are accomplished each spring and fall. There are 14 employees.

•**Aircraft Services (Western) Ltd.:** Subsidiary of Trans-Air Ltd., and located at Winnipeg's Stevenson Airport, this firm handles the aircraft repair & overhaul work for the parent company. It also caters to other civil operators for this type of work. At the present time, Aircraft Services has 42 employees.

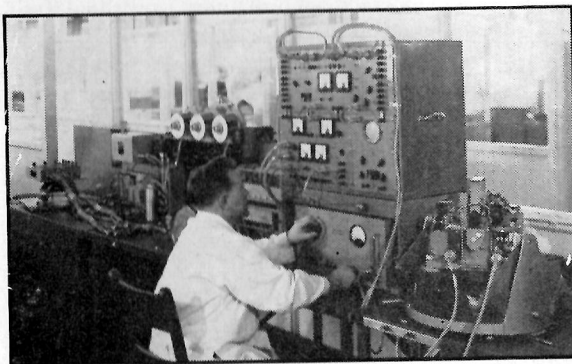
•**Air-Ex Inc.:** Formerly known as Dorval Metalcraft, and located at that Montreal base, Air-Ex engages in varied operations including aircraft repair, overhaul & modification of all types up to and including DC-4; salvage of aircraft and the ferry-out of all types of aircraft; manufacture of parts

and components for civil and military aircraft; and manufacture, modification and repair of ground handling equipment. Additionally, Air-Ex is equipped to manufacture custom sheet metal components for airborne and ground telecommunications equipment.

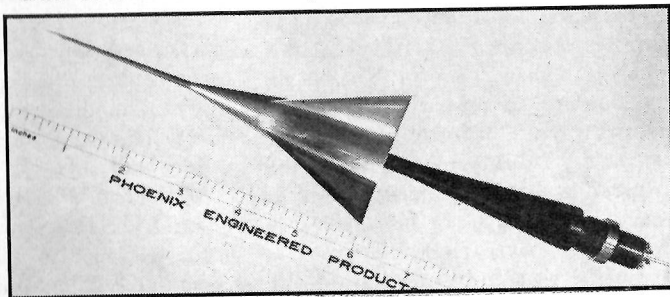
•**Allied Electronics Ltd.:** Situated at Calgary's McCall Field, Allied Electronics is a wholly-owned subsidiary of Technical Enterprises Ltd., Toronto. Allied is engaged in the sales, service and installation of airborne electronic equipment; engineering design and installation of custom executive aircraft communications, navigation and radar systems.

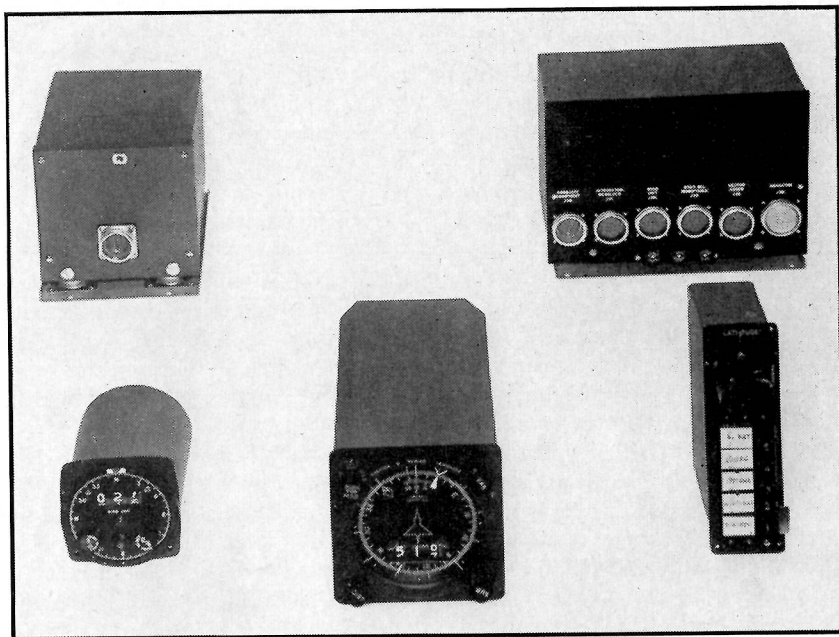
•**Associated Aero Engineering Ltd.:** A subsidiary of PWA, this west coast organization, which is located at Pat Bay Airport, Sydney, B.C., handles sales, service and installation of airborne radio and navigation equipment. Dealers for Collins Radio Co. of Canada, Associated works at repair & overhaul of all types of aircraft radio and navigation equipment.

•**Aviation Electric Pacific Ltd.:** This Vancouver Airport-based company, a subsidiary of Aviation Electric Ltd. of Montreal, has an 8,600 sq. ft. plant devoted to sales and overhaul of aircraft instruments and accessories, airborne and mobile radio, weather radar and marine products. Employing 47 men (up seven from 1957), the company's business is divided equally be-



Above, calibrating a modern electronic automatic pilot at Phoenix Engineered Products. Below, Phoenix-made relative wind sensor, a device used on aircraft or missiles to detect pitch and yaw.





This is Position & Homing Indicator developed by Computing Devices. Three lower instruments are mounted in cockpit; others in any convenient location.

tween military and civil. The company is currently overhauling Bendix units for military and commercial customers. Of special interest is the part this firm is playing in maintaining many accessories for the CPA Britannia fleet.

•**Aviation Radio Ltd.:** Located at Edmonton Municipal Airport, and with a work-force of 8, Aviation Radio provides communications sales, maintenance and installation service for several lines of radio equipment. Activities include custom installations on executive aircraft; custom designed radio control panels; maintenance on all types of aircraft radio and navigation equipment.

•**Avionics Ltd.:** Designers and manufacturers of electronic, mechanical and communication equipment for aircraft and industrial use, this Niagara-on-the-Lake firm also acts as sales agents for British manufacturers of multi-channel airport recorders, accelerometers, and flight test equipment. Avionics' own operations include manufacture of printed circuits and assembly of printed circuits for airborne equipment.

•**Bach-Simpson Ltd.:** An associate of Simpson Electric Co., Chicago, this wholly-Canadian company based in London, Ont., is primarily engaged in the manufacture of instruments for the electronics industry. As one of the largest Canadian instrument manufacturers, 25,000 sq. ft. of plant and 200 men on the pay roll, Bach-Simpson is producing aircraft instruments of the

voltmeter, ammeter and volt-ammeter categories for military aircraft. Company has also in the past, been concerned with the manufacture of major components for radio compass indicators, also for military training aircraft.

•**Bancroft Industries Ltd.:** Located in Montreal, Bancroft Industries is primarily a stocking distributor of aircraft standard parts and instruments, with most of its 80 employees being engaged in this activity. Firm also operates an instrument overhaul facility which accounts for about 5% of its overall business volume. Some 70,000 sq. ft. of plant space is devoted to aviation activities, which comprise the bulk of the company's business. Civil customers are responsible for 25% of the aviation business, with remaining 75% being made up by military contracts.

•**B.C. Propeller Co. Ltd.:** This five-year old Vancouver company incorporates complete overhaul & repair services of all types of metal aircraft propellers and related accessories. Last year Magnaflux and Zyglon inspection equipment for detecting fatigue cracks or defects in ferrous or non-ferrous metals were introduced. Company can accommodate every type of propeller overhaul in the commercial field, and also sells a wide variety of new propellers and parts.

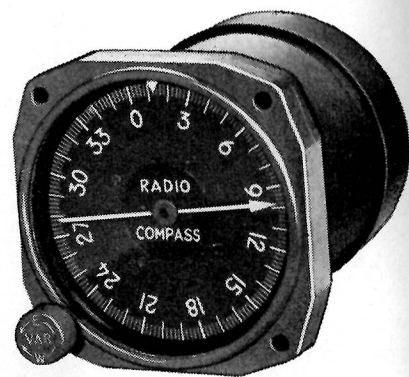
•**Canadian Flight Equipment Co-bourg Ltd.:** Relatively small but progressive, Canadian Flight Equipment, Cobourg, Ont., manufactures ejection

seats for military jet aircraft, as well as ordinary crew and passenger seats. Firm is also active in production of cartridge actuated devices and rocket catapults. With a total of 15 employees, company is engaged chiefly in military projects.

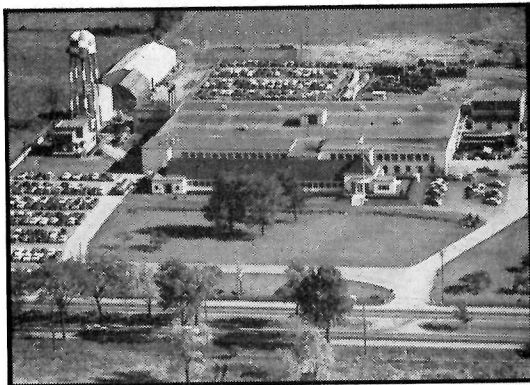
•**Canadian General Electric Co. Ltd.:** With its headquarters in Toronto, this company specializes in consulting, engineering, and manufacturing of military electronic equipment and systems. Further, it supplies General Electric aviation equipment including electrical power equipment, instruments, switches, powerplant and accessories, and other special equipment.

•**Canadian Marconi Co.:** Major products developed by this large Montreal company for the aviation industry are CMA-301 ADF; CMA-402 Loudhailer; and CMA-101/201 HF Transmitter/Receiver. Last year saw the development and production of evaluation models of the CMA-621 Doppler Sensor which are presently undergoing flight evaluation. In addition to equipment of its own design and manufacture, Canadian Marconi has the distributorship for Narco airborne, and Wilcox ground radio equipment. A healthy 80% of the firm's aviation business is directed to civil aviation, the remaining 20% being military contracts.

•**Canadian Pacific Air Lines (Repairs) Ltd.:** Operates as a CPA subsidiary and carries out the function of an RCAF Repair Depot, on contract with the DDP. Work at Calgary's Currie Field embraces inspection, maintenance and repair of a variety of Air Force aircraft ranging through single and multi-engine types to jets, helicopters and flying boats. In addition to



Radio compass indicators were produced at London, Ont., by Bach-Simpson, for use with Bendix radio compass equipment made in Montreal by Northern Electric Company Limited.



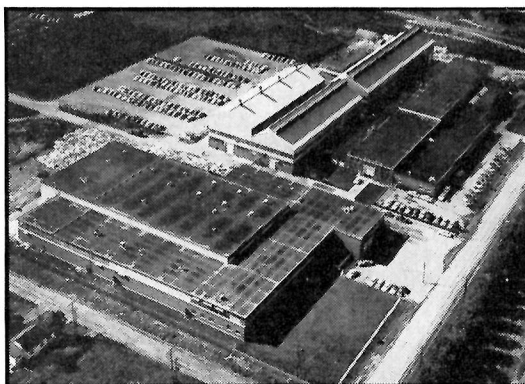
At left is the Canadian head office and plant of Rolls-Royce of Canada Ltd., which is located near Montreal.

Right is shown the recent addition to the Vancouver plant of Bristol Aero Engines (Western) Ltd. Firm is to overhaul Proteus engines for the CPA.



At left appears the big modern engine overhaul facility operated at Montreal by Bristol Aero Engines Limited.

Right, a most important aircraft industry component, the plant of Canadian Steel Improvement Ltd., which is located near Toronto.



normal repair & overhaul, CPA (Repairs) looks after salvage of aircraft as directed by the RCAF, and storage of aircraft at several locations.

•**Canadian SKF Co. Ltd.:** Located in suburban Toronto, the Canadian SKF plant with its work force of 660 men, manufactures ball and roller bearings primarily. Other items include pillow blocks and precision bearings for aircraft engines.

•**Canadian Westinghouse Co. Ltd.:** One of the largest operations of its type in Canada, the Hamilton firm specializes in aircraft electrical power generation, regulation and protective systems for AC and DC requirements. The company is supplying the Canadair Argus with the first aircraft electrical system in the world wired for automatic parallel operation of four engine driven high voltage AC generators. Other items produced are: electrical instruments, temperature control relays, airport lighting equipment, pneumatic valves and anti-skid equipment, communications equipment and radar.

•**Carriere and MacFeeters Ltd.:** One of the industry's fastest-growing companies, this Toronto overhaul plant now boasts 24,000 sq. ft. of space devoted to aviation activities, an increase of 33% in the past year, and 130 employees, up 30 in the same period. The company is concerned with repair & overhaul of 1,100 different types of electrical, hydraulic, pneumatic and instrument components. Also for the manufacture of hermetically sealed miniature and sub-miniature relays and high temperature solenoids. Business volume is divided 72% military, and 28% civil operators. Carriere & MacFeeters is Canadian distributor for aircraft instruments manufactured by U.S. Gauge, and by the Kenyon Instrument Co.

•**Central Aviation Ltd.:** Situated at Stan Reynolds Airport, Wetaskiwin, Alta., Central Aviation is active in repair & overhaul of light aircraft. Having a work area of 6,840 sq. ft., and hiring 6 men full-time, Central concerns itself entirely with civil aircraft. It also holds the Piper dealership for central and northern Alberta.

•**Curtiss-Reid Mfg. Co. Ltd.:** Operating in 11,000 sq. ft. of plant space at Montreal's Cartierville Airport, Curtiss-Reid's 15 employees are engaged in the overhaul & repair of fabric covered components for DC-3, North Star and Piper products, etc. Although 85% of the work is in the repair & overhaul

line, remainder is in manufacture of gas and oil tanks for such aircraft as DC-3's and Norsemen. Airframe repairing is done on all types of light and medium aircraft.

•**D & S Aviation Co. Ltd.:** Located at Pont Viau, Que., D & S employs 12 men in a 3,300 sq. ft. work area for the overhaul & repair of light aircraft powerplants and allied accessories such as starters, generators, carburetors, fuel pump, vacuum pumps and propeller governors.

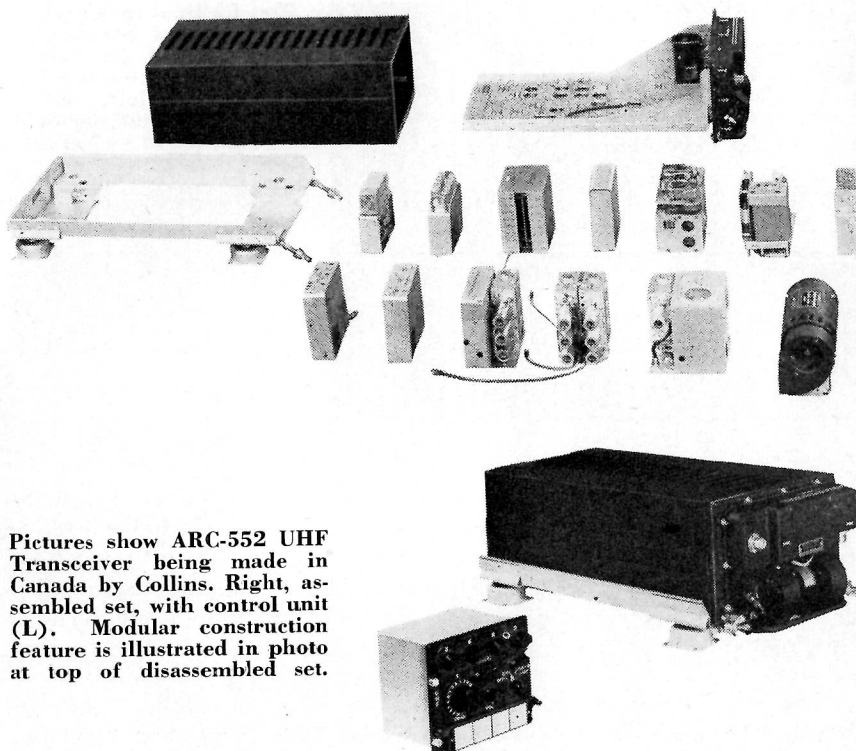
•**Dunlop Canada Ltd.:** The Toronto located Dunlop firm is quite naturally concerned with the sales and service of Dunlop tires and other aviation equipment. The company manufactures aircraft tires and aviation products involving the use of rubber.

•**Edo (Canada) Ltd.:** Just one year old, Edo's Cornwall, Ont., 20,000 sq. ft. plant has just started operations. The 35% of total business volume that is credited to the aviation industry involves the manufacture and sale of aircraft floats and amphibious landing equipment, as well as airborne loran and radar. Though building airplane floats for 32 years, the parent Edo organization in the U.S. has, in the past 10 years, become increasingly engaged in the development of all forms of sonar and related equipment. Ninety per cent of the firm's business is with the civil market.

•**Elliott Bros.:** Engaged solely in the manufacture of wooden skis for civil aircraft, this two-man operation in Sioux Lookout, Ont., does not handle other components. Limited overhaul work is done on skis of Elliott manufacture.

•**Ferranti Electric Ltd.:** Only 8% of the Ferranti plant in Toronto is devoted to aviation purposes, and in that 30,000 sq. ft. of space are found 108 employees working on aviation products. At present, Ferranti is building gyro attitude indicators for the RCAF, and paper tape readers for the USAF. Repair & overhaul work is being done on a variety of gyro equipment, and tape handling equipment. Company sells fire control systems, vertical and rate gyros, gyro control units, attitude indicators, and stabilized platforms. Some 95% of Ferranti's aviation business is for the military.

•**Flight Refuelling (Canada) Ltd.:** Situated in suburban Toronto, Flight Refuelling is engaged in the design, development, testing and manufacturing of fuel system equipment for air-



Pictures show ARC-552 UHF Transceiver being made in Canada by Collins. Right, assembled set, with control unit (L). Modular construction feature is illustrated in photo at top of disassembled set.

craft. The company is a subsidiary of the U.K.'s Flight Refuelling Ltd. and is presently working on the fuel equipment for the Avro CF-105.

•**Found Bros. Aviation Ltd.:** Located at Malton Airport, Toronto, Found manufactures aircraft temperature instruments; ground handling equipment; magnetic clutches; tension controls. With a 15-man staff and a work area of 3,780 sq. ft. devoted to aviation projects, the company's aviation business is 90% military. Other activities include manufacture of precision dynamometers and torque meters for servo components; also research on actuators, servo controls, ground handling equipment and temperature indicating devices.

•**Garrett Mfg. Corp. of Canada Ltd.:** Is a wholly-owned subsidiary of The Garrett Corp., Los Angeles. The Canadian firm's 11,000 sq. ft. plant in the Toronto suburb of Rexdale comprises sales and engineering offices and shop facilities. Employing some 60 personnel (up 30 in the past year) Garrett's projects include repair, overhaul and manufacture of a number of highly specialized aircraft components in the instrument and electrical fields. Over 80% of the company's effort is directed toward providing sales representation in Canada for such companies as Air-Research and Air Cruisers, both U.S. divisions of The Garrett Corp.

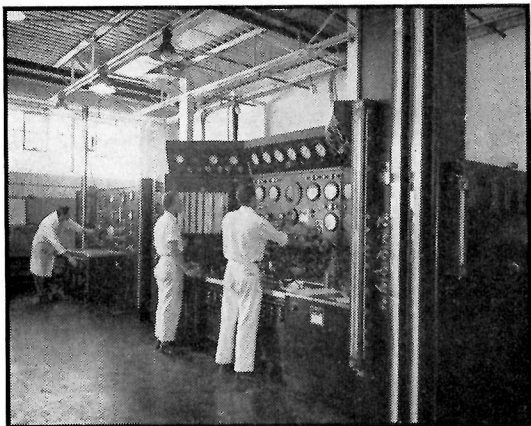
•**Genaire Ltd.:** With its main plant

at St. Catharines, Genaire has a Toronto hangar used mainly for maintenance and storage of civil aircraft. Company is engaged in repair, overhaul, maintenance and engineering of airframes, components and accessories. A subsidiary firm, Gensales Ltd., handles a number of lines of aviation products. Total plant area (St. Catharines and Malton) is 60,000 sq. ft., employees number 115. Business is divided equally between civil and military.

•**Godfrey Engineering Co. Ltd.:** Of Lachine, Que., has a plant area of 10,000 sq. ft. devoted to aviation pursuits, with work split between civil and military. Company is affiliated with the U.K.'s Sir George Godfrey & Partners Ltd., designers and manufacturers of cabin pressurization systems. Canadian company also designs and manufactures a wide range of aircraft ground servicing equipment including hydraulic test stands, pressure testing trollies, etc. There are 55 employees.

•**Dominion Rubber Co. Ltd.:** With plants in Montreal and Kitchener, Ont., Dominion Rubber engages in the design, manufacture and repair of fuel cells, fittings and rubber accessories. Presently working on fuel cells for the CF-105, CF-100, CL-28, CS2F, and Otter aircraft.

•**B.F. Goodrich Canada Ltd.:** Located in Kitchener, Ont., this well-known rubber firm devotes 10% of its work facilities to the manufacture of aviation products. These include



Test facilities in Winnipeg plant of Standard Aero include jet fuel flow control test stand (R) and, left, HP fuel pump test stand.

tires, tubes, wheels and brakes; anti-skid devices; canopy and inflatable seals; de-icers (inflatable, electro-thermal, and electro-thermal metal clad); pressure sealing zippers; high altitude flying suits; Rivnuts; and various types of hoses.

•**Goodyear Tire & Rubber Co. of Canada Ltd.:** This Toronto firm is engaged in the manufacture, sales & service of aircraft tires, tubes, wheels and brakes. Firm also concerns itself with sales and service of such U.S. Goodyear-produced items as anti-skid warning systems, de-icers, radomes, life rafts and life vests. Goodyear is supplying main-wheels, tires and brakes for the CF-105.

•**Grand Valley Air Services Ltd.:** Located at the Waterloo-Wellington Airport, near Kitchener, Grand Valley specializes in engine and airframe overhaul work. Other activities include crop spraying and charter and non-scheduled flying operations.

•**Husky Aircraft Ltd.:** This west coast organization has its headquarters at Vancouver Airport. Chief activity has been the development of an Alvis Leonides 503/8 powered conversion of the Fairchild F-11 Husky. Company plans to put this newly developed version of the Husky bush plane into production.

•**Instrument Repair:** Whose 4,000 sq. ft. of plant space in Edmonton is chiefly devoted to aviation work. With all of its business centred in the civil field, about 75% of its operation is repair & overhaul work. This includes all aircraft instruments and small accessories as well as service work on aircraft in electrical and instrument installation and custom instrument panels. There are now 9 employees, as compared to 15 a year ago.

•**Irvin Air Chute Ltd.:** This long-established Fort Erie, Ont., firm pro-

duces and repairs all types of personnel and cargo parachutes. Other items in the line include deceleration parachutes, air stabilizer parachutes, radar reflecting parachutes. Irvin is also active in the manufacture of anti-"g" suits, pressure breathing waistcoats and ventilation suits. In addition, company supplies Irvin Mk V automatic parachute opening device. Research and development is carried on continuously. Employees number 50.

•**Walter Kidde & Co. of Canada Ltd.:** This Montreal firm has its main plant in Montreal, with 20,000 sq. ft. of space and 70 men working on Kidde aviation products. The firm offers a line of air compressors for airborne use, giving pressures of 3,000 or 5,000 psi. Kidde deals in all phases of fire protection for aircraft, including a continuous strip type fire detector. Company also handles complete line of chemical, water and foam portable extinguishers.

•**Laurentian Air Services Ltd.:** Operates complete aircraft and engine overhaul facilities at Ottawa Airport. The engine overhaul plant is approved for all aircraft engines up to 600 hp. With a work-force of 32 men, and plant space of 14,750 sq. ft., Laurentian is a well-established company.

•**Leavens Bros. Ltd.:** With headquarters in Toronto, Leavens is one of the best-known aviation firms in Canada. It manufactures the Fleet 80 and, as subcontractors to de Havilland Canada, supplies welded assemblies and machined parts for the Beaver, Otter, and CS2F projects. It is also engaged in the fabrication of reinforced plastics for RCAF and commercial uses. Other activities include repair & overhaul of engines and airframes; propeller and accessories; instrument and radio overhaul. The firm devotes nearly 30,000 sq. ft. of plant to aviation activities, up

6,000 sq. ft. in the past year. There are 55 employees. Leavens conducts a Canada-wide aircraft parts and supplies sales business which comprises about 60% of its overall aviation business.

•**Leggat Aircraft Ltd.:** Located at Buttonville Airport, north of Toronto, Leggat engages in the repair & overhaul of aircraft airframes and engines. Firm handles Champion Aircraft sales and service for planes and accessories.

•**Martin-Baker Aircraft Co. Ltd.:** Solely concerned with the repair, overhaul and modification of Martin-Baker ejection seats, this firm has a 10,500 sq. ft. plant area in Collingwood, Ont. The company employs some 80 men.

•**Noorduyn Norseman Aircraft Ltd.:** The new plant erected at Cartierville Airport, boasts 40,000 sq. ft. of working space. Here manufacture of spare parts goes on, as well as servicing of Norseman and other aircraft, and overhaul & repair of floats and skis. About 85% of company's efforts are devoted to civil operators; 15% to military. Noorduyn has licensing agreements with Eastern Rotorcraft Corp., and Ledkote Products, both of the U.S.

•**Normalair (Canada) Ltd.:** This organization is a subsidiary of the U.K.'s Normalair Ltd., and is located in Toronto. Primary concern is liaison, service, research & development for equipment made by the parent company and used on Comet, Viscount, Britannia. Balance of Canadian firm's effort is on development, design and production of assorted items for Avro Arrow: pressurization, flow control, cooling equipment, humidifiers, water separators, etc.

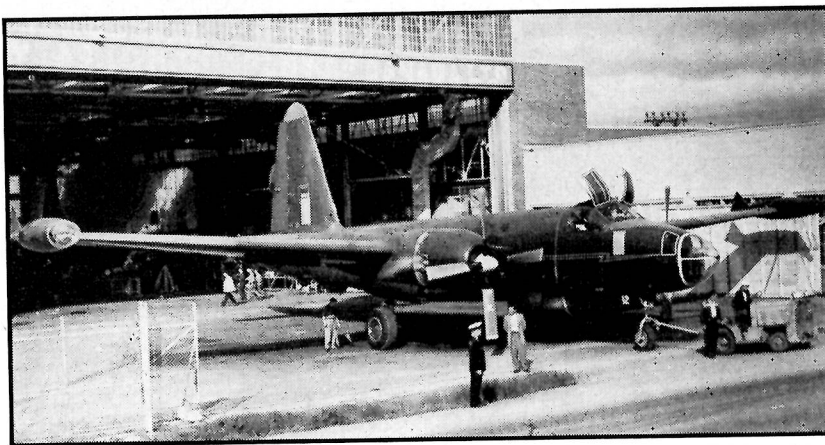
•**Philco Corp. of Canada Ltd.:** This large electronic manufacturer contributes only a portion of its total facilities to aviation. Toronto plant engages in the manufacture of airborne radar equipment for the CS2F, which is its chief military project. Other contracts are for electronic training material for use in military, technical and vocational schools, as well as universities.

•**Pioneer Parachute Co. of Canada Ltd.:** Of Smiths Falls, Ont., is a subsidiary of Pioneer Parachute Co. Inc., Manchester, N.Y. Company manufactures all types of parachutes and such fabric products as tow targets, webb assemblies, engine tents, and wing covers.

•**Preco Progress & Engineering Corp. Ltd.:** This Toronto firm has been a member of Canada's aviation



At Eastern Passage, N.S., Fairey of Canada specializes in the maintenance, repair and overhaul, and modification of naval aircraft for the RCN, and maritime aircraft for the RCAF. Above, a line of Banshees; below, Neptune after overhaul and modification.



industry for many years. Designer and manufacturer aircraft hydraulic controls (valves, cocks—manually, hydraulically, or electrically operated); remote controls; ground equipment and instruments. Company also does machining of precision aircraft parts; light metal design and applications.

•**Radio Communications Equip. & Engineering Ltd.:** Lachine, Que., designers and manufacturers of electronic equipment for general and specific applications. Currently designing and manufacturing 15 radar target simulators for use with DoT surveillance radar systems. Company is fabricating, from its own design, a quantity of high power, LF aeronautical beacons.

•**Sanderson Aircraft Ltd.:** Temporarily set back by loss of its hangar quarters at Malton Airport by fire last month, Sanderson Aircraft soon recommenced operations on a smaller scale. Temporary headquarters are in the Toronto Flying Club's hangar at Malton. Company is engaged in repair & overhaul, sales & service of aircraft and engines. It is a distributor for Cessna aircraft; LearCal products; and

Continental engines.

•**Saskatchewan Government Airways:** Operating out of Prince Albert where SGA maintains a small plant for overhaul and scheduled inspections of its fleet of 24 aircraft. Commercial work is accepted on private aircraft up to 20,000 lbs. gross, and engines up to 900 hp. A small manufacturing division makes ski boards for Cessna 180 and Beaver aircraft, and pneumatic ski pedestals for Cessna, Beaver and Norseman aircraft.

•**Servomechanisms (Canada) Ltd.:** Designs and produces precision computation and control systems and instrumentation, specializing in the air data field. Transducers, computers and related components, such as amplifiers, power supplies and positioning mechanisms are produced in Canada. The 20,000 sq. ft. plant, located in the Toronto suburb of Rexdale, is an RCAF approved repair & overhaul facility. Company serves as world-wide distributor of the electronic and electromechanical components produced by its U.S. parent, Servomechanisms Inc. Company activity is mainly (75%) in

the manufacturing line, and most of this (95%) is for the military field. There are 48 employees.

•**Sky Harbour Air Services:** This company, with a total of 6 men on its payroll, is located at Goderich, Ont. It specializes in aircraft repair & overhaul, and in aircraft refinishing. It is here that Canada's first postwar ultralight aircraft to be granted a C of A was built.

•**Smart Aviation Ltd.:** Subsidiary of of Okanagan Helicopters, Smart is located at Toronto's Island Airport. Activities include repair & overhaul of helicopters, as well as light fixed-wing aircraft.

•**S. Smith & Sons (Canada) Ltd.:** The Canadian subsidiary of the U.K.'s Smiths Aircraft Instruments Ltd., situated in Toronto suburb of Don Mills. Firm handles all sales & service in Canada for the parent company, as well as for associated companies: Kelvin & Hughes Ltd.; K.L.G. Ltd.; and Waymouth Gauges & Instruments Ltd.

•**Spartan Air Services Ltd. (Helicopter Div.):** With company headquarters in Ottawa, Spartan's less-than-a-year old helicopter overhaul & repair facility is located at nearby Uplands Airport. Work is done on RCAF and RCN helicopters, as well as on civil types. This \$250,000 plant primarily concerns itself with maintenance of Spartan's own helicopter fleet. In addition, Spartan gives helicopter pilot and engineering courses.

•**Standard Telephones & Cables Mfg. Co. (Canada) Ltd.:** This Montreal company is engaged in the design and manufacture of MF radio beacons; VHF direction finding equipment; ground radio transmitters. Some 25,000 sq. ft. of Standard's plant, about 25% of total, is devoted to aviation products, though aviation work represents nearly 50% of total volume of business. Company also sells VHF airborne transmitters/receivers; and radio altimeters.

•**Superior Airways Ltd.:** This Fort William, Ont., firm has 16,000 sq. ft. of plant area devoted largely to repair & overhaul work of civil aircraft. Superior Airways manufactures Model 1500 Pee-Kay floats, and does research & development work on aircraft skis and floats; is a dealer for Cessna airplanes, Federal and Fly Lite skis. Company is equipped to overhaul aircraft with gross weight under 8,000 lbs.

•**Technical Enterprises Ltd.:** Based at Toronto's Malton Airport, this

(Continued on page 119)

likely effect upon ICBM detection, the joint project will begin this summer.

INDUSTRY CROSS SECTION

(Continued from page 80)

specialty firm provides sales, service and installation of airborne electronic equipment. In addition, company handles engineering design and installation of custom executive aircraft communication, navigation and radar systems.

•**Thompson Products Ltd.:** Chief role of Thompson Products' aviation div. lies in forging of aluminum, titanium, and alloy steel blades for gas turbines. Although the bulk of its work is for U.S. manufacturers, Thompson also sells to Rolls-Royce of Canada, Orenda Engines, and Canadian P & W.

•**Radium Dial Corp.:** A Montreal firm, this company employs 20 on the manufacture and refinishing of instrument dials. It is also agent for U.S. Radium Corp. Lackon edge-lit panels.

•**Cannon Electric Canada Ltd.:** Located in Toronto, Cannon of Canada manufactures a variety of electrical connectors for use in several aircraft applications, including powerplant, communications, landing gear, radar, lighting, etc.

•**Timmins Aviation Ltd.:** Located at Montreal Airport, Timmins Business Aviation Centre caters to the executive aircraft trade. With 68,000 sq. ft. of space devoted to aircraft repair, overhaul and conversion to executive standards, Timmins is the largest operation of its type in Canada. Company is also engaged in the sale of parts, materials, aviation fuel and such aircraft as used and new Beechcraft, Grumman Gulfstream and Trecker Royal Gull. Conversion activities centre principally around DC-3, Lodestar and PBV aircraft. Employees number 105.

•**United Aviation Ltd.:** This firm is situated at Edmonton Municipal Airport. United's 21 employees are engaged on major overhaul work on airframes and engines. Company also handles aircraft sales, and provides for maintenance, accessory overhaul, and aircraft storage.

•**Western Airmotive:** Formerly known as Vancouver Aircraft Sales, this Vancouver company deals in aircraft service and repairs mainly (90%) for the civil market. Western Air-

motive is also a supplier of spares, and sells new and used aircraft. Other activities include instrument and radio overhaul, repair and sales. Company does limited repairs on rotary wing aircraft. Plant area is 45,000 sq. ft.; employees number 20.

•**Vertol Aircraft Co. (Canada) Ltd.:** This Arnprior, Ont., company was originally known as Piasecki Helicopter Co. of Canada Ltd., and is a subsidiary of Vertol Aircraft Corp., Morton, Penn. Company is active in repair, overhaul and modification of Vertol helicopters for the RCAF and the RCN. It manufactures spare parts, and runs service trials for Vertol helicopters.

•**The Weatherhead Co. of Canada Ltd.:** Although only 15% of Weatherhead's St. Thomas, Ont., factory is

devoted to aviation production, firm is well-known in Canada's aviation industry. Chief items are fittings and house connections; the parent U.S. Weatherhead organization pioneered flareless fittings on this continent. The Canadian company boasts a completely equipped environmental test lab in its aviation division.

•**York Gears Ltd.:** One of the largest companies of its type in Canada, Toronto's York Gears employs some 250 men (down 50 since last year) in an 80,000 sq. ft. plant. Working entirely on military contracts, 80% of the company's effort is in design, development and manufacture of gearboxes, universal shafts, gears, and precision components. It is a major supplier to Orenda Engines, Avro Aircraft, Canadian P & W, Rolls-Royce of



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•**Bata Engineering:** A manufacturing firm which has 35,000 sq. ft. (80% of total area) devoted to aviation activity, this Batawa, Ont., firm fabricates hydraulic component parts and aircraft structural parts. These include structural and undercarriage parts for CF-100 and CF-105. Complete hydraulic components are built for Canadian Car's Harvard spares department. Bata Engineering also makes detail parts for Canadair, DH Canada, Enheat, and CanCar for the CS2F; also for Goodyear for wheels and brakes on Beaver, Otter, Caribou and Arrow aircraft.

•**The Brunswick-Balke-Collender Co. of Canada Ltd.:** This Toronto firm has 25,000 sq. ft. of space (representing about 20% of total) devoted to aviation production. Company is concerned here chiefly with such reinforced plastic components as radomes, fin tips, etc. These items are all made under sub-contract to Canadian manufacturers of military aircraft.

•**Canadian Sundstrand Aviation Ltd.:** A new firm with its headquarters in Toronto, is a subsidiary of Sundstrand Machine Tool Co., Rockford, Ill. Sundstrand supplies constant speed drive systems for the Argus and the Arrow, and will be supplying equipment for TCA's new DC-8's. The new Canadian subsidiary will provide engineering and service support for these systems, and plans to establish a facility for production as well as repair & overhaul of Sundstrand products.

•**C.P. Clare Canada Ltd.:** A new subsidiary company in Canada, C.P. Clare has set up headquarters in Toronto. It is manufacturing and selling Clare electronic products, including relays, switches and related electrical components designed by the parent C.P. Clare Co., Chicago.

•**Consolidated Diesel Electric Corp. of Canada Ltd.:** This wholly-owned subsidiary of Consolidated Diesel Electric Corp., Stamford, Conn., is located in the Toronto suburb of Rexdale. Con Diesel of Canada is engaged in manufacture of multipurpose ground support equipment for conventional, jet and rocket aircraft, including CF-105 and CP-107. Other projects include test equipment for industry, the mili-

tary, and automation. Company also designs and produces power equipment for industry and defence purposes.

•**Heatex Ltd.:** Formerly known as Lawrence Radiators Ltd., this Montreal firm is concerned with repair & overhaul of all types of aircraft heat exchangers, including components valves. Heatex is a Rolls Royce approved contractor for aircraft heat exchange equipment. There is a Toronto branch also.

•**Leland Electric Canada Ltd.:** Though only a small part (5%) of Leland's total production is devoted to aviation goods, the Defence & Special Products Div. of the Guelph, Ont., firm takes up 10,000 sq. ft. of manufacturing space. The Division was set up in 1957 to co-ordinate all phases of development and marketing of aircraft components and electronic equipment. Included in list of products made are: inverters, generators, high speed alternators, missile inverters, gas turbine alternators, solenoids, actuator motors and transformer rectifiers. Most of the 15 employees' effort (90%) is on behalf of the military market.

•**Liquidometer of Canada Ltd.:** This Montreal firm is a subsidiary of the

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U.S. company, The Liquidometer Corp. The Canadian firm devotes its activities principally to repair & overhaul of such Liquidometer aircraft instruments as fuel quantity gauges (both float operated and capacitance type), position indicators, and transmitters for aircraft use.

•**Parmatic Engineering Ltd.:** Working mainly (90%) on military contracts, this Owen Sound, Ont., company designs, develops, manufactures, and overhauls all types of filters (air, oil, or fuel). Recent projects include supplying hydraulic filters for the Avro Arrow. Parmatic also manufactures and overhauls a wide range of pressure switches for both gauge, differential and vacuum applications. Another activity is the fabrication of temperature probe type fire detectors. Plant area devoted to aviation is now 8,000 sq. ft., up 5,000 sq. ft. since last year; employees number 50, up 20 since 1957.

•**Prairie Equipment & Radiators Ltd.:** This small Winnipeg firm has 10 employees and deals almost exclusively in repair & overhaul of aircraft oil regulators and oil coolers. The firm also supplies ski brass, hydraulic jacks, aircraft control cable, etc.

•**Precision Rubber Products (Canada) Ltd.:** Headquarters and main plant for this firm is at Ste. Therese de Blainville, Que., while a branch office is maintained in Toronto. Company is engaged in manufacturing hydraulic "O" ring seals for aircraft and industrial applications.

•**Thor Industries Ltd.:** Located in suburban Toronto, this firm manufactures under sub-contract to de Havilland Canada, crew seats for the CS2F. Thor is also engaged in manufacture of oil line equipment for Orenda. Company does RCAF approved inert gas welding for various aircraft manufacturing firms.

•**Garratt Aircraft Ltd.:** This company's fixed assets were completely wiped out by a disastrous fire which destroyed its Malton hangar quarters in February. Fortunately the loss was completely covered by insurance, and the company has resumed operations in temporary quarters in the vicinity. Main activity is the production of aircraft components under sub-contract to de Havilland Canada. Prior to the fire Garratt had plans to build a new plant north of Malton Airport, and these will be put into effect as quickly as possible. Employees normally aver-

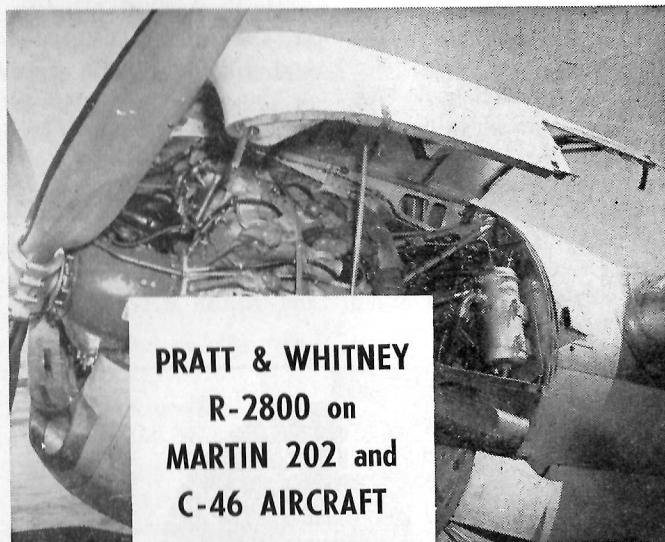
age 65 in number.

•**Western Propeller Co. Ltd. and National Servicaire Co. Ltd.:** Western Propeller, which is well known for its propeller and governor overhaul and repair activities, has recently branched out into overhaul & repair, sales and service, of aircraft and engines. This work is carried out by Western's subsidiary, National Servicaire. A new engine test cell has been constructed, capable of accommodating Lycoming, Continental, Franklin, and P & W R-985 and R-1340. It is planned to have common types of engines available on an exchange basis. The two firms have

a combined plant area of 20,000 sq. ft. and employ a total of 20.

•**English Plastics Ltd.:** This comparatively new firm was formed recently to take over the fabrication division of Crystal Glass & Plastics Ltd. Firm employs 15 in a 10,000 sq. ft. plant at Brampton, Ont., and engages in the fabrication, in clear acrylic of aircraft canopies, windows, windcreens, and astral domes, and in laminated Fiberglas of covers and ductwork.

•**Simmonds Aeroaccessories of Canada and Simmonds Products of Canada Ltd.:** These associate firms recently



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moved from Montreal to new quarters in Hamilton with 10,000 sq. ft. of plant area. In their new location, the Simmonds firms plan gradually to expand repair and service facilities, eventually manufacturing a selection of suitable components, for which they are Canadian licensees, that are now manufactured elsewhere to Simmonds specifications. Included in line of proprietary aircraft accessories which Simmonds supplies and services in Canada is fuel gauging equipment used in TCA aircraft.

•**Daystrom Ltd.:** Formed recently at Toronto to handle sales, service assembly and manufacture of Daystrom Inc. electronic products in Canada. Manufacture of gyros and accelerometers for aircraft and guided missiles is planned at Canadian subsidiary's new plant.

•**Rotaire Ltd.:** An affiliate of Genaire Ltd., Rotaire specializes in helicopter repair, overhaul, maintenance and engineering, catering to needs of Canadian operators of military and civil rotary wing aircraft. Firm is supported by Genaire's shop facilities at St. Catharines and Malton. Working

parties provide technical service in the field.

SPARROW

(Continued from page 88)

torpedo that has been developed by the Canadian Armament Research & Development Establishment. Practically nothing has been said officially about this weapon, but it is slated for service with both the RCN and the RCAF, presumably as armament for the CS2F-1 Tracker and the CP-107 Argus.

Although there is now some evidence of progress in the Canadian missile program, there is still little indication as to what the next step might be. As C. F. Hembury, president of Computing Devices of Canada, said at the 1957 AITA general meeting:

"Canada's place in missile development is not yet clear. The basic question is this: Can Canada afford to support a full scale development program on one or more types of guided missiles specifically adapted to Canadian defence, or must we rely on American and British developments? We have

tried both ways, with the Velvet Glove and the Sparrow 2. If we attempt to manufacture foreign developments, we must accept the delays which this approach entails. If we try to do our own research and development, we must be prepared to bear the costs.

"The costs of development are considerable, and it is inevitable that much work already done elsewhere must be duplicated because of security restrictions. The argument in favor of manufacturing under license is mainly economy. We avoid duplication of effort, and we save engineering man hours. On the other hand, we may lose up to two or three years in getting a missile into operational use.

"In favor of developing our own missiles, it is said that against the money cost must be balance the value of building up a reservoir or experienced personnel which we can use if we find ourselves unable to obtain equipment from our allies."

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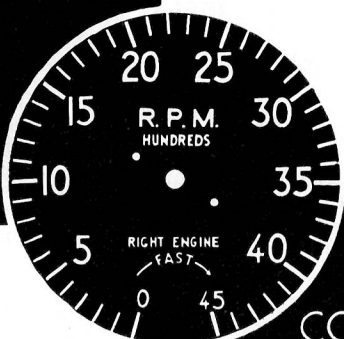
(Continued from page 94)

(10%). In this way it was possible to finance the deal privately. A new company has been formed called "Aircraft Manufacturing Co. Ltd.," or "Aircor". Rolls-Royce, in their usual manner, are financing the engines. It was recently announced that the Government had given British European Airways the go-ahead to negotiate with de Havillands and their associates for the D.H. 121 jet transport. So in the end it looks as though de Havillands have won the race. And the British Government has achieved a measure of success in their prodding for an integration of industry.

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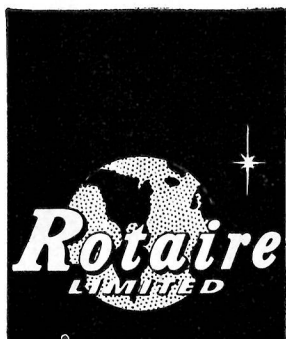
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